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THE UNIVERSITY OF ALBERTA

THE STANDARD PROGRESSIVE MATRICES

IN A MULTI-ETHNIC MILIEU

by

JOHN B. ACHESON

A THESIS

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The undersigned certify that they have read, and
recommend to the Faculty of Graduate Studies and
Research, for acceptance, a thesis entitled "The
Standard Progressive Matrices In A Multi-Ethnic Milieu"
submitted by John B. Acheson in partial fulfilment of
the requirements for the degree of Doctor of Philosophy.

# ABSTRACT

The objective of the present study was to develop
a local set of norms for the Standard Progressive
Matrices and to compare these norms to those developed
by Raven and reported in the test manual. Concomit-
antly, tests of reliability, construct validity, and
concurrent validity were carried out. Finally the
Progressive Matrices was examined in both a varied
socio-economic and cross-cultural context.

Seven hundred and thirty-six twelve, thirteen and
fourteen year old students were randomly selected from
the junior high school grades in the Edmonton Separate
School System. An additional twenty-eight twelve and
fourteen year old students were selected from grades
six and ten respectively. A sample of 106 Canadian Indian
students was drawn from the same population for the cross-
cultural studies. Grade and age norms expressed in per-
centiles were developed plus a table of norms expressed
as deviation intelligence scores.

As hypothesized, the norms developed in the present
study differed significantly from those developed by
Raven. A Kolmogorov-Smirnov Test showed the difference
to be significant beyond the .001 level for the grade seven
and eight students and beyond the .01 level for the grade
nine students. In each case the students in the current

study scored significantly higher than the students in Raven's study.

Using the KR 20 formula, internal consistency measures of 0.86, 0.82 and 0.88 were calculated on the Matrices for the grade seven, eight and nine students respectively. The Gates MacGinitie Reading Survey and the Wisconsin Contemporary Test of Elementary Mathematics were used as criteria in calculating respective concurrent validity measures of 0.45 and 0.59. Similarly construct validity measures of 0.34 and 0.61 were calculated using Canadian Lorge-Thorndike verbal and nonverbal intelligence scores as the criteria. While all correlations calculated were significant, the correlation between the verbal intelligence scores and the Progressive Matrices is considered to be low.

Scores on the Progressive Matrices were essentially unaffected by socio-economic status. However, differences between the native and the non-native sample were found to be significant at the 0.01 level for the grade seven and eight students. The difference was not found to be significant at the grade nine level.

# ACKNOWLEDGEMENTS

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# CHAPTER I

## INTRODUCTION TO THE STUDY

### I. INTRODUCTION

In recent years there has been a growing awareness on the part of educators of the child who does not fit the stereotype of the average or normal student. Parent groups, governments, school boards, universities, and teachers have promoted the development of special education settings which would facilitate the optimum educational experience for each child whatever his handicaps or strengths. In reaction to this pressure school systems have established, in addition to a variety of "levels" within the regular school program, special classes for the mentally retarded, emotionally disturbed, culturally deprived, neurologically impaired, and mentally gifted.

Because of these special classes there has arisen an increased interest in measuring a student's scholastic achievement in relationship to his intellectual ability. It is in fact suggested that most education philosophies promote the concept of adapting instruction to the needs and abilities of the individual students (Rattan & MacArthur, 1968). It appears therefore that educators should be cognizant of a student's ability and be capable of comparing this with his actual

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academic progress. Marked differences between the two could be an indication of a "learning problem" or a "teaching problem". Cronbach (1960) further suggests that mental ability tests ought to help locate undeveloped potential that a unique educational program might bring out.

Related to the foregoing is the ever present interest in prediction. Countless research projects have been carried out which attempt to determine how effectively specific tests or specific criterion predict future behavior or future success. Once again, to use the educational setting as an example, it has often been the practice to direct a student into a particular program and indeed a particular vocation on the basis of the results of a specific testing program. This point is reinforced by Evens (1970) and by Vernon (1970) when they claim that assessment of intellectural potential of pupils has prognostic as well as diagnostic value. That is, future academic or general success is often predicted on the basis of intellectual potential as determined through the use of an intelligence test. MacArthur (1968-a) summarizes this line of thinking when he states:

> ... *to the extent that we can implement*
> *a philosophy calling for teaching pro-*
> *cedures and curricula so adapted as to*

*maximize realization of the present*
*intellectual potential of individuals,*
*and if we are attempting to predict*
*to distant and general goals, theoret-*
*ical consideration of constructs like-*
*ly to be involved in predictor-goal*
*relationships become useful, perhaps*
*definitely necessary.  Hence a need for*
*criteria for the construct validity*
*of measures of present intellectual*
*potential.*                              (p. 45)

## II.  BACKGROUND TO THE PROBLEM

It would appear that the search for an ac-
ceptable definition and measure of intelligence has,
for many years, been one of the major pre-occupations
in the field of psychology.  It can also be seen from
the foregoing  that school systems are faced with a
continuous and growing demand for accurately assessing,
among other characteristics, the intellectual and cog-
nitive abilities of its students.  Results of intellec-
tual assessments are often used to determine a stu-
dent's placement in a special program or special set-
ting.  Having accepted this mandate, the school systems
thus must cope with the problem of selecting the most
viable methods and instruments available which can

accurately assess the level of intellectual function-
ing of the students.

The decision on what instrument(s) to ut-
ilize depends on a number of factors: reliability and
validity of the instrument(s), cost of the program
both in terms of qualified personnel and in terms of
direct financial outlay for materials, logistics of
administration and scoring, functional utility of the
results, numbers of students that can be assessed in
specific time periods, and availability of normative
data.  It is generally agreed that individual intelli-
gence testing tends to be more valuable than group
testing.  This is particularly true in clinical diagnosis.
However, standardized group tests are often, of
necessity, chosen by school systems because of the
above mentioned factors.  There is pressure therefore
to find group tests which could serve as general screen-
ing instruments that would meet some of the needs as
expressed in the opening paragraphs of this chapter;
i.e. assessment of present level of intellectual
functioning and prediction of future level of intell-
ectual functioning.

### III.  PROGRESSIVE MATRICES

One such instrument that can be utilized as
a group test in addition to being used as an individual
or self-administered test is the Standard Progressive

Matrices which was developed and normed by Raven in Great Britain. This is a nonverbal intelligence test which was designed to measure Spearman's general factor of intelligence. (This "g" factor will be discussed in the following chapter.) The test is reputed to provide a measure of the capacity to form comparisons, to reason by analogy and to develop a logical method of thinking regardless of previously acquired information (Westby, 1953).

In order to counteract specific application limitations with the original test, Raven has developed two variations. The Progressive Matrices (1947) A, AB, B (Colored Progressive Matrices) was developed for use with very young children and mentally subnormal or impaired individuals, while the Progressive Matrices (1947) Sets I and II was designed to discriminate among elite individuals in the top quarter of the population. This study, however, will concern itself only with the (revised) original instrument, Standard Progressive Matrices (1938). Henceforth in this study the test will be referred to as the Progressive Matrices or simply the Matrices.

## IV. STATEMENT OF THE PROBLEM

The Progressive Matrices is not meant as a substitute for the Binet or Wechsler tests, nor for any

verbal or nonverbal group test of mental ability,
however it is considered by Burke (1958) to be almost
as useful in that it shows inter-correlations with such
tests perhaps as high as they show with each other.
While the Progressive Matrices has been extensively
used in England, its use in North America has been
comparatively limited.  It is suggested that this lack
of use results from the fairly general notion that the
test requires improvement in regard to validity and
normative data (Burke, 1958).  As stated by Blumenkrantz,
Wilkin and Tuddenham (1968):

> ... *the normative sample though very*
> *large, is not well described in Raven's*
> *manual, and information on the relation-*
> *ship between the Progressive Matrices*
> *and other measures is only slowly*
> *accumulating.*                    (p. 931)

It is felt that if these improvements could be brought
about, particularly in the area of normative data, that
the Progressive Matrices could become a useful research
and educational tool in North America.

While a number of research projects have been
carried out in recent years in Canada using the
Progressive Matrices (MacArthur, 1962; MacArthur, 1965;
MacArthur, 1968-b; Rattan and MacArthur, 1968; West
and MacArthur, 1964) these have been generally restricted

to the examination of intellectual functioning in native children.  There is a marked lack of reported research on the use of the Progressive Matrices in an urban Canadian setting.  It would further appear that the actual use of the Progressive Matrices in the Edmonton area, a Canadian city of approximately one half million people, is almost negligible.  Wechsler (1960) would suggest that this general lack of use is somewhat unfortunate as the Progressive Matrices could be a welcomed addition to psychometrics because it constitutes a definite contribution to the field. Westby (1953) reinforces this thinking when he "warmly" recommends the use of the test to North Americans.

Although the test as mentioned above is easy to administer, has a great deal of intrinsic motivation, is economical, and can be administered to groups by competent teachers, the lack of local norms tends to militate against its use in the Edmonton area.  It is felt that if local norms were available that the Progressive Matrices could become an integral part of the total testing program in a large urban school system where a general screening instrument is required.  This is particularly important where the school system has a relatively large number of Indian and Metis pupils, a relatively large number of ethnic students from various European countries, and a relatively diverse socio-

economic population. A "culture-reduced" test such as the Progressive Matrices given in conjunction with the regular academic testing program could help to distinguish between present intellectual potential and present level of performance (Hebb, 1958). It could provide teachers and counsellors with a less biased estimate of the potential of not only pupils who are the product of different cultures and different socio-economic backgrounds but also of pupils who come from a background that is considered to be "average" (Pedrini, 1972).

## V. PURPOSE OF THE STUDY

Based on the foregoing, the purpose of this research project was to provide information which would allow for the effective use of the Progressive Matrices in the Edmonton area. The specific objectives of the study were:

1. To develop normative data for the Progressive Matrices for use with the grade seven, eight, and nine pupils in the Edmonton Catholic School System which has a total student population slightly in excess of 30,000.

2. To examine the internal reliability of the Progressive Matrices.

3. To validate the Progressive Matrices as given to the grade eight students with the Canadian

Lorge-Thorndike Intelligence Test which is administered to the grade eight students as part of their regular testing program.

4.    To validate the Progressive Matrices as given to the grade seven students with their scores on the standardized grade six reading and arithmetic tests. The standardized achievement tests involved are the Gates MacGinitie Reading Survey and the Wisconsin Contemporary Test of Elementary Mathematics.

5.    To note the relationship between the socio-economic status of the students as determined by the Blishen Index and the scores obtained on the Progressive Matrices.

6.    To compare the performance of a sample of native students with the performance of a sample of non-native students on the Progressive Matrices.

CHAPTER II

THEORETICAL CONSIDERATIONS

AND

RELATED LITERATURE

The presentation of related literature is
divided into three major sections, each having a spe-
cific relationship to the problem in question.  The in-
itial section of this chapter outlines the research
which deals with the history of intelligence testing.
The second section reviews the literature on the nature
of intelligence.  This section outlines the positions
taken by a number of the dominant theorists in the
field of intelligence testing and research.  Following
immediately from this review an attempt is made to for-
mulate a definition of intelligence.  The final section
briefly reviews the relationship between socio-economic
status and success on intelligence tests and academic
achievement tests.  The literature dealing specifically
with the Progressive Matrices will be dealt with in
Chapter III.

I.  THE SEARCH FOR INTELLIGENCE

The history of intelligence testing can be
said to begin around the turn of the century with the
work of Alfred Binet.  The school authorities of Paris
requested Binet to develop a set of tests which could be

used in the objective identification of mentally de-
ficient school children in order that they might be pro-
vided with a more appropriate curriculum.  Binet and
his associate, Simon devised a number of tests of atten-
tion, memory, discrimination, etc. which could be per-
formed by average individuals (. McMahon, 1974).  By
rank ordering these tests from easiest to hardest they
attempted to discover each child's level of mental de-
velopment.  Binet and Simon felt that it was possible
to: determine in a scientific manner the mental level
(intelligence) of a child, compare this level with the
level of the other children and thus determine by how
many years a child might be retarded.  Operating on
this belief Binet and Simon, during the initial revisions
of their test, developed the procedure of relating mental
age and chronological age (McMahon, 1974).

One of the major shortcomings in Binet's
tests was his failure to control for differences in the
language and cultural background of the testees (Lindgren,
Byrne, and Petrinovich, 1961).  In order to overcome
some of these factors psychologists at Stanford
University undertook the development of the Stanford-
Binet Intelligence Scale.  This scale followed the
guidelines established by Binet.  Terman, whose influence
on North American concepts of intelligence is probably
unparalleled, devised the first of these scales in 1916.

In collaboration with Merrill he devised the second one in 1937. This second scale which was more extensive and consisted of two forms, L and M, became the most extensively used device for the individual testing of children's intelligence to that time. The concept of the intelligence quotient was introduced along with the 1916 revision following a suggestion by Terman's contemporary, Stern. In 1960 a final revision of the Stanford-Binet was undertaken by Terman and Merrill. This revision incorporated the "best" items from the L and M forms and became known as the Stanford-Binet, Form L-M. This test, with a few minor revisions, is the instrument in use today.

Shortly after the publication of the initial Stanford-Binet the military authorities in the United States were faced with the problem of determining how hundreds of thousands of recruits could be classified for the purpose of determining military assignments. At the request of the United States Army a number of members of the American Psychological Association set out to develop a method by which large numbers of recruits could be quickly assessed. Based on the work of Otis they developed the Army Alpha, and the Army Beta tests. The former is a verbal test while the latter is a nonverbal test designed for use with persons unable to read English and for illiterates. During the second world war two similar tests were in-

troduced: Army General Classification Test and the
Armed Forces Qualification Test. These tests like their
predecessors were intrinsically interesting while
their administration and scoring were easily carried
out. The use of these tests on large numbers of recruits
demonstrated the practicality and the value of group
intelligence testing and opened the way for many tests
of similar design (Lindgren, et al, 1961).

Following the army's success with group test-
ing, similar group intelligence tests were developed
and introduced into the public schools during the 1920's
with the hope of improving the efficiency of education.
The group tests appeared to offer a method by which the
students could be easily and quickly classified accord-
ing to ability. The theoretical rationale behind such
a classification program was to adapt curriculum and
methodology to the level of the students. While the
idea has not worked out as well in practice as it did
in theory, Lindgren, et al (1961) feel that the use of
intelligence tests did introduce teachers to the concept
of individual differences. This in turn has resulted
in intelligence testing becoming a standard procedure
in most school jurisdictions.

One of the more recently developed group
tests is the Lorge-Thorndike Intelligence Test which
was developed in 1954 with a Canadian version being

developed in 1967. The original standardization group, which consisted of 136,000 school children, was selected to provide proportional representation of the various socio-economic levels in the U.S. (Lorge, Thorndike, & Hagen, 1972). The test consists of verbal and nonverbal items and provides such information as the individual's intelligence quotient and his percentile rank. Canadian norms have recently been published for the Lorge-Thorndike which has resulted in extensive use being made of the test in Canadian schools.

While the group tests provided a general screening device for the purpose of selection and class-ification they were not always functional for diagnostic purposes. The Stanford-Binet did provide some clues that aided in the diagnosis of various types of emotion-al and intellectual dysfunctioning. However it provided only one score and did not appear to be particularly adaptable for use with adults. There was also an ex-tremely heavy weighting given to verbal material which appeared unfair to individuals who were not verbally inclined but appeared intellectually competent.

In an attempt to overcome some of the criti-cisms of the Stanford-Binet, Wechsler developed the Wechsler-Bellevue Intelligence Scale in 1939. The primary function of this scale was to provide an intelli-gence test suitable for adults. In 1949 Wechsler

introduced the Wechsler Intelligence Scale for Children which was designed as a downward extension of the Wechsler-Bellevue. Wechsler in 1955 redesigned the Wechsler-Bellevue into the Wechsler Adult Intelligence Scale. The Wechsler scales are considered to be a descendant of the Binet-Simon scales and consist of both a verbal and a performance (nonverbal) scale.

One of Wechsler's primary motives behind the development of his tests was to produce an instrument that could be utilized in diagnosis of various mental and emotional disorders. Research, however, has not supported Wechsler's original claims that various subscore combinations have diagnostic significance. Experienced clinicians, however, have been able to gain a good deal of diagnostic information from analyzing the manner in which a subject responds and by analyzing the "quality" of responses (Lindgren et al, 1961).

While Binet and Simon were developing the first intelligence tests in France, Spearman was exploring intelligence from a different aspect in England. He and his co-workers were attempting to identify and isolate the "factors" that make up intelligence. In attempting to discover the nature of intelligence Spearman pioneered the factor analytic movement of modern psychometric research. His research also led directly to the work of Raven who explored possible

techniques whereby intelligence could be measured while reducing the effects of environmental influences.

## II. THE NATURE OF INTELLIGENCE

Upon examination of the literature it becomes apparent that there are three major models by which one can come to understand the nature of intelligence. The first model originates with a group of psychologists who view intelligence as consisting of two factors. They take as their basis the work of Spearman. The second model stems from the work of a group of psychologists who view intelligence as consisting of a number of individual factors. Among the most noteworthy of these theorists, who are referred to as "group factor" or "multiple factor" theorists, are Thurstone and Guilford. Wechsler can also be considered as a member of this group although he does not take as rigid a position. The third group which includes Hebb, MacArthur and Vernon attempts to reconcile the two opposing schools.

A. *Two Factor Model of Intelligence*

The two factor model of intelligence originated with the work of Spearman in England around the turn of the century. Spearman (1927) viewed intelligence as consisting primarily of a general factor "g" which is common to every ability plus specific factors "s".

Each "s" factor is specific to a particular task or ability and can be considered as independent of "g" and of all other "s's".  The two factor theory accounts for the fact that mental tests generally show positive intercorrelations with each other (Krech, Crutchfield, and Livson, 1970).  In explaining his theory, Spearman posited that many different skills "tap" the common pool of general ability "g".  Such diverse abilities as musical ability, mathematical ability, spelling ability, etc. show a correlation with each other (admittedly this is often low) because they all require a certain amount of the common ability "g" (Munn, 1966).  But skills such as mathematics require, in addition to "g", specific mathematical abilities "s" which might include facility with numbers, ability to factor, ability to multiply, etc.

Terman (1954) working in America, supported Spearman's concept of intelligence when he stated:

> ... *that to achieve greatly in almost*
> *any field, talents have to be backed*
> *up by a lot of Spearman's "g", by*
> *which is meant the kind of general*
> *intelligence that requires ability to*
> *form many sharply defined concepts,*
> *to manipulate them and to perceive*
> *subtle relationships between them.* (p. 224)

In like manner Cattell (1943) in an extensive review of the theory relating to the nature of intelligence defended Spearman's "g" as a useful construct both in understanding intelligence and in intelligence testing.

Figure 1 illustrates the basis for correlation among tests according to Spearman's theory (Anastasi, 1968). It can be seen that tests 1 and 2 correlate highly with each other since each is highly saturated with "g", as shown by the shaded areas. The white area in each test represents specific abilities plus error variance. Test 3 which contains very little "g" is not highly correlated with the other two tests.
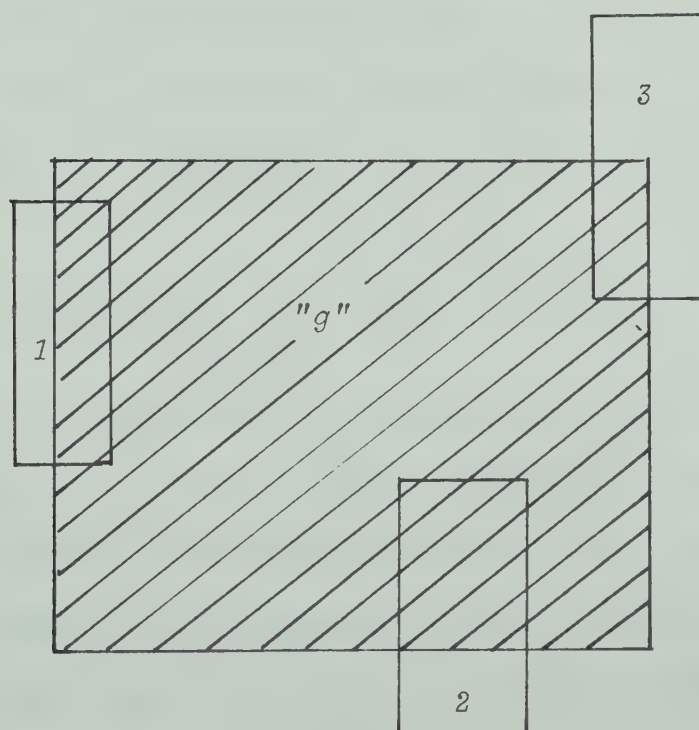


Figure 1

*Two-Factor Model of Intelligence*

Spearman's view of one general factor of in-
telligence has been challenged with the claim that there
are other factors besides "g" which account for inter-
correlations between tests of intelligence.  However,
his demonstration of the existence of at least one
pervasive factor in all performance requiring intellec-
tual ability is considered to be one of the great dis-
coveries of psychology (Wechsler, 1958).  In addition
to this major discovery Spearman was the first psychol-
ogist to apply factor analysis in the study of intellec-
tual abilities.  Through factor analysis Spearman was
able to apply a "stringent" test to his notion that
there is one general ability present in all abilities.
He developed and applied the test of tetrad differences.
He felt that if there is a single ability common to
four tests the relationship among the correlations would
be:

$$r_{1'2} \; r_{3'4} - r_{1'3} \; r_{2'4} = 0$$

As explained by Deese (1967) the equation
shows that the product of the correlation between tests
1 and 2 and the correlation between tests 3 and 4 is
exactly equal to the product of the correlation between
tests 1 and 3 and the correlation between tests 2 and 4.
The equation is expressed such that the difference be-
tween the cross products of the correlations is zero.

The difference should be zero if all the tests have just one common factor. Deese (1967) points out however, that when a single general factor is removed, some correlation between the tests remain (except in very rare and unusual cases). While proponents of Spearman claim that this residual correlation is a function of statistical error it is generally accepted that there are other factors besides "g" that account for intercorrelations between tests of intelligence (Wechsler, 1958). These residual correlations led other psychologists to conclude that Spearman was only partially correct in regard to his general factor of intelligence. Spearman himself in his later formulations also included certain group factors in his theory of intelligence (Anastasi, 1968). These included such factors as arithmetic, mechanical, and linguistic abilities. This position however did not suggest a reduction in the importance or prevalence of "g".

B.  *Multiple Factor Model of Intelligence*

In contrast to the two factor theorists a number of psychologists have taken exception to the claim that there is a general intelligence factor. They feel that what Spearman refers to as "g" is itself analyzable into a number of subsidiary factors. One of these psychologists, Thurstone, came to the conclusion that because we cannot account for all the correlation

between tests by just one factor there must be two or more such factors.

Figure 2 illustrates the intercorrelations among five tests in terms of a multiple factor model. The correlations of tests 1,2, and 3 with each other results from their common loadings with the verbal factor (V). In like manner the correlation between tests 3 and 5 results from the spatial factor (S). The correlation between tests 4 and 5 results from the number factor (N). It can be seen that tests 3 and 5 are more complex in that they have a loading in more than one factor.
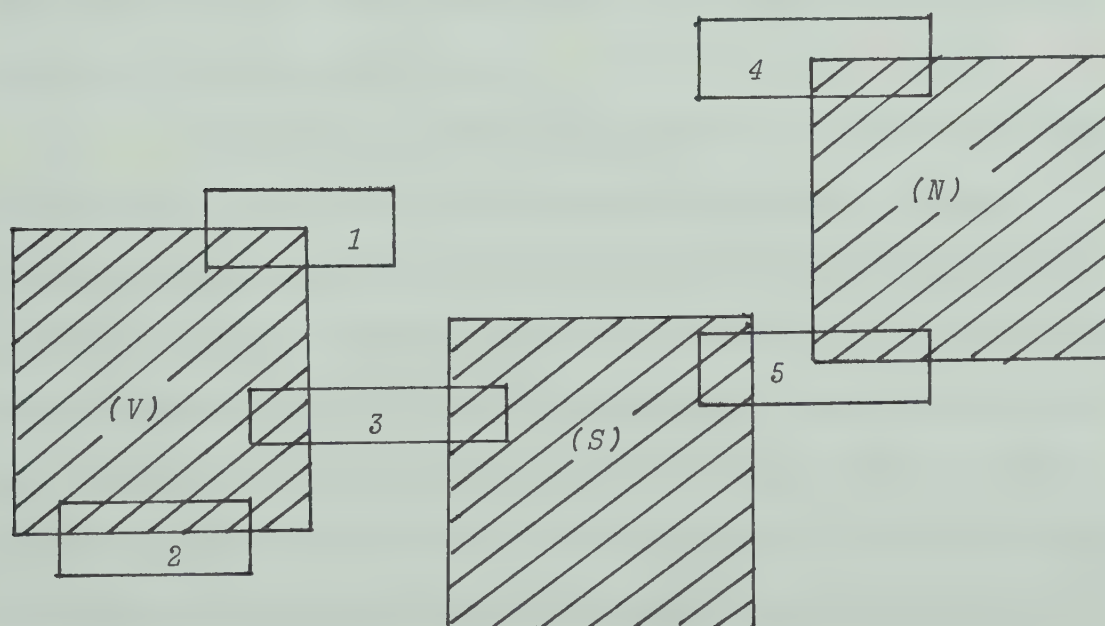
Figure 2

*Multiple-factor Model of Intelligence*

Spearman's experimentation with the tetrad-difference equations led Thurstone to a new method of factor analysis in an attempt to isolate the factors of intelligence. Thurstone (1947) developed a general procedure called multiple factor analysis for determining the pattern of factors that accounts for the correlations between different tests. In this procedure one common factor is first extracted from all the tests and then the residuals are computed from the correlation coefficients. A second factor is extracted from the residuals and so on until the residuals have been almost completely exhausted. Through this procedure a set of factors can be identified plus the weighting each test has in a particular factor.

Thurstone (1938) postulated, through his work with factor analysis, that there were seven primary mental abilities that could account for the mental capacity of man. These included the ability to perform the four fundamental arithmetic processes (number ability), the ability to write and speak with ease (word fluency), the understanding of ideas in word form (verbal meaning), the ability to make recall (memory), the ability to solve problems (reasoning), the ability to perceive size and spatial relationships correctly (spatial perceptions), and the ability to identify stimulus objects quickly (perceptual speed). The Thurstone Primary Mental Ability

tests were developed to assess each of these mental abilities. Thurstone, however did not find these primary mental abilities to be independent of each other as a large residual variance remained after factor analysis. Wechsler (1943) claims that this might be due to the insufficient number of variables entering into the correlation matrix. The fact that these abilities were shown to correlate positively with each other tends to support Spearman's model of a common factor in each ability (Krech, Crutchfield, and Livson, 1970). This opinion reinforces the findings of Morris (1939) who after isolating thirty two variables was still able to account for only thirty-five percent of his total correlational variance.

Guilford (1959) also promotes a group factor theory of intelligence. His model is organized around three main aspects of human functioning: operations, content and products. An operation is a major intellectual process and includes such things as evaluation, convergent thinking, divergent thinking, memory and cognition. An operation is performed upon certain kinds of information called content which may be figural, symbolic, semantic, or behavioral. Applying an operation to content yields a product. The product is the form that information takes once it is processed. It may yield units, classes, relations systems, transfor-

mations or implications (Guilford, 1959). It can be
seen that Guilford's model of intelligence involves 120
abilities; eighty of these have been identified through
tests (Lefrancois, 1972). Krech et al (1970) suggests
that the practical test of the validity of this pro-
liferation of factors (and of tests to measure them),
lies in their ability to predict behavior better than
is possible by a single test score. Krech et al (1970)
point out however that available evidence is not con-
clusive in this regard. In like manner they suggest
that this group factor theory has not led to a better
theoretical understanding of intelligence.

Wechsler (1958) not unlike Thurstone and
Guilford views intelligence as consisting of separate
identifiable facets which can be individually measured.
In his earlier writings, Wechsler (1943) noted that
attempts to appraise intelligence in terms of global
capacity, that is, the ability or abilities to deal
effectively with any specific situation, results in in-
complete measures of the individual's capacity for in-
tellectual behavior. He claims the reason for this
incomplete or inaccurate measure of intellectual ability
is the fact that intelligence tests, as now constituted,
measure effectively only a portion of the capacities
that enter into intelligent behavior. In other words,
Wechsler feels that the limitations of intelligence

tests are due to their deficiencies of content.

Wechsler differs somewhat from Thurstone and Guilford in that he does not deny the existence of a general factor in explaining the nature of intelligence. He feels however that the measure of this factor is best achieved through the assessment of specific skills such as verbal ability, abstract reasoning, arithmetical skills, etc. He also stresses that there are additional characteristics which also have a direct influence on intelligent behavior. He refers to these as non-intellective factors in general intelligence; they include all affective and conative abilities which in any way enter into global behavior. Stated differently, Wechsler (1958) sees intelligence as the aggregate or global capacity of an individual to act purposefully, rationally, and effectively. Intelligence is global because it is composed of elements or abilities which are qualitatively different but which at the same time are dependent and interrelated with each other. Wechsler (1958) feels that while intelligence is not a mere sum of intellectual abilities, the only way that it can be evaluated is by the measurement of the various abilities which make up intelligence. That is, intelligence cannot be evaluated as a unitary characteristic.

## C.  *Hierarchical Model of Intelligence*

A third school of thought presents a model of
the nature of intelligence which attempts to incorpor-
ate the best features of the two factor model and the
multiple factor model.  Four of the major proponents of
this model include Burt (1949), Hebb (1958), MacArthur
(1968-b), and Vernon (1965).  This model attempts to
explain the nature of intelligence by combining gener-
al intellectual ability, which has a high index of her-
edability (Pezzula, 1972), and special intellectual abil-
ities in a hierarchical structure.

At the top of the hierarchical model is gen-
eral intellectual ability which is similiar to Spearman's
"g".  Further down the hierarchy are group factors sim-
ilar to Guilford's concepts of operations, content and
products, and to Thurstone's ability factors of number
ability, word fluency, etc.  The emphasis on these
factors varies depending upon the tasks and persons de-
fining them (MacArthur, 1968-b).  Vernon (1965) points
out that after removing the general factor from the top
of the hierarchy (by some factor analytic procedure) the
positive residual correlations always fall into two
main categories: the verbal-educative group and the
spatial-practical-mechanical group.  Vernon suggests,
and MacArthur agrees, that these second order (hier-
archical) abilities can be further sub-divided into an

almost unlimited number of increasingly specific a-
bilities.  The hierarchical model is diagramatically
represented in figure 3.
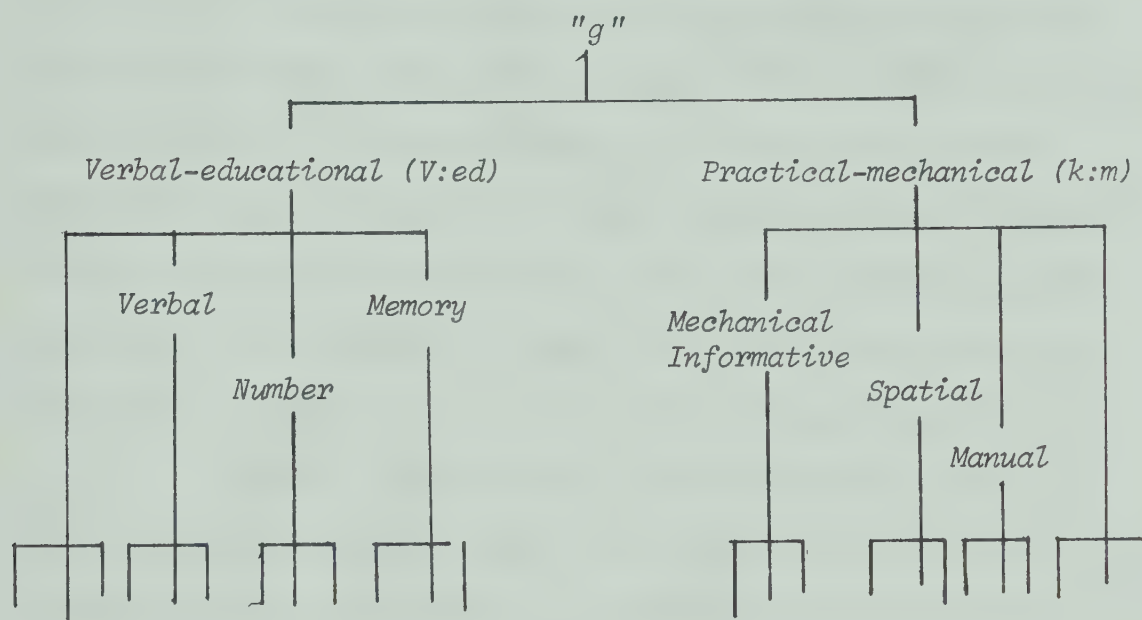


Figure 3

*Hierarchical Model of Intelligence*

Both Vernon (1965) and Krech et al (1970)
feel that the issue between the two factor and multiple
factor models is perhaps a non-issue when viewed in terms
of the hierarchical model.  They felt that both Thurstone
and Guilford erred in two areas in their interpretation
of intelligence.  The first of these is concerned with
the population that is usually dealt with in large scale
intelligence testing research.  These authors suggest

that the reason for the popularity of the multiple
factor approach, which in its pure form denies the ex-
istence of "g", is because much of the work in intellec-
tual assessments is done with homogeneous groups such
as "regular" school students, college students, armed
forces personnel, etc.  The range of "g" in these groups
tends to be so restricted that in effect only group
factors can be obtained through factor analysis.  Vernon
(1965) stresses this point when he claims that in most
research, particularly in that involving older subjects,
the sample is highly selected and less representative.

Vernon (1965) points out the second short-
coming in the interpretation of intelligence by the
multiple factor theorists.  He feels, and this is sup-
ported by Burt's (1940) writings, that Thurstone and
Guilford erroneously regarded primary intellectual
factors as fundamental components of the mind, which in
combination make up all  the important human capacities.

Spearman's position is also "corrected" by
Vernon (1965).  He felt that Spearman erred by viewing
"g" as being determinate and unchanging other than that
which results from physiological maturation.  While "g"
has a different loading on various intelligence tests
it must not be viewed as a definite entity or autono-
mous mental faculty (Hebb, 1958).  Hebb suggests that
it be thought of in terms of a cumulative formation of

more and more complex and flexible phase sequences or in Piagetian terms, schemata. That is, "g" grows, develops, and matures as a result of interaction between the individual and his environment. Thus "g" at any one point in time is the product of the innate potential for cognitive development and the cumulative influence of environmental experiences. It follows from this view of intelligence that nature and nurture are inseparable in the production of intelligent behavior (West and MacArthur, 1964). It is this developed and developing "g" that is tested with instruments such as the Progressive Matrices (Thorsen, 1971).

Vernon summarizes his position regarding the non-issue between two factor and multiple factor models by pointing out that a useful and accurate assessment of an individual's ability can be determined by applying the hierarchical model. He suggests that a test of "g" such as the Progressive Matrices combined with a test of verbal ability could provide an accurate assessment of present intellectual functioning. This could be supplemented by a specific group-factor test such as mechanical, clerical, etc. if a specific skill was being sought. In other words measures of ability that are high in the hierarchy generally have better external validity and more generalizability to living, whereas many of the primary factors are specific to particular tasks (Cronbach & Rajaratnam, 1963).

D.  *Intelligence Defined*

In concluding this section on the nature of intelligence a theoretical definition of intelligence will be proposed.  Historically the pragmatic nature of intelligence tests has overshadowed the theoretical need to adequately define intelligence.  While psychologists have failed to come to terms with the problem of definition, the issue has resulted in extensive debate, much of which has been extremely useful, such as the nature-nurture issue, the two factor-multiple factor issue, etc.

The definition of intelligence that will be adopted for this study is derived primarily from the work of Hebb (1958) and MacArthur (1968-a).  The definition consists of two parts, A and B.  Intelligence A is the innate potential for cognitive development.  This potential can be looked on as having two facets: A, the innate potential for cognitive development with which an individual is born and A[1], the present potential of an individual for future cognitive development, assuming that optimum future treatment is adapted to bring out that potential.  Secondly, intelligence B is a general or average level of development of ability to perceive, to learn, to solve problems, to think, and to adapt.  This second part of the definition, B, involves the personality factors that Wechsler (1958)

feels are so important to intellectual functioning.

West and MacArthur (1964) suggest that while it is impossible to directly measure intelligence A or A[1]; it is possible to measure intelligence B. If in doing so the variance in intelligence B which is attributable to environmental factors is minimized, the resulting score will be a reasonable measure of intelligence A[1] which is the present potential for future development, assuming optimum conditions. This position is reinforced by Rapaport, Gill, and Schafer (1968) who believe that when a subject takes an intelligence test, his performance represents his efficiency of functioning at that time. They go on to state that this efficiency or this intellectual potential is not necessarily a final and unchangeable characteristic. Like West and MacArthur (1964) they feel it will be greatly influenced by future environmental stimulation. West and MacArthur (1964) found that the Progressive Matrices was a test that, through reducing cultural variance, was able to provide a reasonable estimate of present intellectual potential.

III. SOCIO-ECONOMIC STATUS

It is a generally accepted hypothesis that intelligence is the product of both hereditary endowment and environmental influences. While the question of the relative importance of heredity and environment is

far from settled it would appear that they both exert
an essential influence on intelligence.  Hebb (1958)
stresses this point when he states:

> ... *to ask how much heredity con-*
> *tributes to intelligence is like*
> *asking how much the width of a field*
> *contributes to its area.*  (p. 120)

Elley (1961) concludes that their importance varies to
the extent that one is held constant while the other
changes.

Socio-economic status is one such environmen-
tal variable that has received extensive attention in
the research literature with the conclusion that there
is a marked positive relationship between socio-economic
status and intelligence test scores (Anastasi, 1958; E
Elley, 1961; Hebb, 1958; Sperrozzo and Wilkins, 1959;
Tesi and Montemagni, 1962; Tyler, 1953).  Related
studies have also shown similar relationships between
socio-economic status and school achievement (Anderson,
1971); delinquency (Scarfe, 1974) and various other
indices of "social adjustment".  These studies were
further confirmed by Koubekova and Miklova (1973) in
an extensive study involving 20,000 students.  They re-
ported that parents' education and occupation were both
significantly related to their children's intelligence.
They also noted that parents' occupation was an impor-

tant determinant of their children's academic success. Income per family, standard of housing and cultural setting were also found to be related to academic success.

A number of instruments have been devised to assess socio-economic status, one of which is the Blishen Index (1958). This index or scale was developed from data derived from the Canadian National Census. It is based on occupation, mean income, and number of years of schooling. Olsen and MacArthur (1962) have used it to determine socio-economic status of junior high school students in Edmonton. The Blishen Index is considered to be an objective measure of socio-economic status suitable for use in Canada (Olsen, 1962).

# CHAPTER III

## STANDARD PROGRESSIVE MATRICES

In 1958 Burke made what appears to be an exhaustive and critical review of the literature available on the three forms of the Progressive Matrices tests--the Standard Progressive Matrices, the Progressive Matrices (1947) Set I and II, and the Colored Progressive Matrices. Since this research project was planned to utilize only the Progressive Matrices this review will be limited to that literature which is relevant to that instrument. The procedure will be to report on Burke's summary and to update his review by examining the literature from 1958 until the present.

### I. PROGRESSIVE MATRICES: DESCRIPTION

As viewed by Westby (1953) the Progressive Matrices is:

> ... *a nonverbal test of a person's*
> *capacity at the time of the test to*
> *apprehend figures presented for his*
> *observation (Spearman's Principle*
> *of Experience), see relations be-*
> *tween them (Spearman's Education of*
> *Relations), and conceive the correl-*
> *ative figures completing the systems*
> *of relations presented (Spearman's*
> *Education of Correlates).* (p. 418)

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It is further described by Westby (1953) as
a test which is simple to administer, usually enthral-
ling, and generally acceptable to the dull and clever,
the young and old, and the friendly and defensive.
The test is made up of logically designed patterns
(matrices) which serve to measure what Raven (1938)
refers to as "innate educative ability ", "educative
intelligence", or simply "education".

Wechsler (1960) views the Progressive Matrices
as an excellent test of general intelligence.  He also
sees it as an extremely interesting attempt at assess-
ing intelligence in that it is the first attempt at
measuring intelligence in terms of or through a single
intellectual function--visual perception.  This is a
marked departure from the Binet tests and the Wechsler
tests which attempt to assess intelligence through a var-
iety of intellectual functions such as memory, know-
ledge, perception, reasoning, spatial relations, etc.
This departure is emphasized by Westby (1953) who
stated:

> The concerted attack by Spearman, Burt
> and the British "g" school of factor
> analysis upon the empirically composed
> heterogeneous test as developed by
> Binet and his American followers se-

*cured its first indubitably spectac-*

*ular success in Raven's Progressive*

*Matrices.* (p. 418)

The Progressive Matrices consists of sixty designs or matrices divided into five sets (A B C D and E) of twelve problems each. Each problem or matrix consists of a network of logical relations between two dimensional, visual geometrical forms. Each matrix has a "gap" which must be filled by the testee who selects the correct choice from six or eight alternatives printed below the matrix. The relations within the matrix usually allow for more than one method for analysing the problem. The themes employed are: (a) continuous patterns, (b) analogies between pairs of figures, (c) progressive alterations of patterns, (d) permutations of figures, and (e) resolution of figures into constituent parts.

Abstract reasoning by analogy is described by Carlson (1973) as the most advanced form of reasoning in that it requires logical solutions of the type involved in the operational solution of class inclusion problems. Therefore the solution of Progressive Matrices is not made by configural symmetry or thematic representation (graphic processes) but through the operation of multiplicative classification.

Carlson (1973) concludes therefore that the test is a suitable measure of higher thought processes that derive from analytic and integrating operations.

The test is designed so as to produce five sets each progressively graded in difficulty both between and within sets. The first problem in each set is intended to be self-evident and is succeeded by eleven problems of increasing difficulty. The items and sets are of a sufficient range of complexity to discriminate in a short testing time a sample of the general population (Westby, 1953). A final characteristic of the test is that it is considered to be culturally reduced in that it tends to reduce the influence of formal academic training, language development, socio-economic background, and cultural "deprivation" (West and MacArthur, 1964; Meeker and Meeker, 1973).

## II. PROGRESSIVE MATRICES: HISTORY AND USE

It was the work of Spearman and Burt with their concept of a general factor of intelligence that could be considered the originating stimulus for the development of the Progressive Matrices by Raven (Burke, 1958). The test quickly grew to be the most widely used of British intelligence tests in that it was administered to over three million members of the military during the second world war. Its use in

North America has been comparitively limited.  However
it is proving to be increasingly useful in racial and
cross-cultural studies as a measure of general intell-
ectual potential (Jensen, 1959; MacArthur, 1968-a;
Sperrozzo and Wilkins, 1959).  Tesi and Montemagi (1962)
have also compared socio-economic status and intelligence
using the Progressive Matrices.  Burke (1958) reports
it as having been extensively utilized in research with
special groups such as: the deaf, the cerebral palsied,
mental defectives, psychiatric patients, child guidance
clinic patients, university students and apprentices.

III. PROGRESSIVE MATRICES:  CONSTRUCT VALIDITY

Raven's (1940) original purpose for designing
the Progressive Matrices was to develop a test of a
person's "present capacity to form comparisons, reason
by analogy, and develop a logical method of thinking re-
gardless of previously acquired information".  Other
English psychologists notably Spearman (1946), Vernon
(1947) and Vincent (1952) view the Progressive Matrices
as perhaps the purest test for measuring "g".  West
and MacArthur (1964), Rattan and MacArthur (1968) and
MacDonald and Netherton (1969) reinforce this opinion
with their findings that the test while not being cul-
ture free can certainly be looked on as a culture-reduced
test and thus an acceptable test of "g".  Rimoldi (1948)
found that the Progressive Matrices was culture reduced

in that it did not depend to any large extent upon the
education or the amount of information possessed by
the subjects.  Burke (1958) however does not feel that
proof exists to show that the test is a pure measure of
Spearman's construct of "g".

Burke (1958) notes that the highest correlation
found between the Progressive Matrices and other intel-
ligence tests was .86 with the Terman-Merrill.  This
was reported by Raven himself in 1939.  Smith (1958)
in a more recent study with exceptional children found
a correlation of .74 between the Progressive Matrices
and the Stanford-Binet.  Smith who views this as a mod-
erate to high correlation is reinforced by Sitkei and
Michael (1966) who report a correlation of .65 between
the Stanford-Binet and Progressive Matrices which they
find to be significant.

The correlations between Progressive Matrices
and the Wechsler tests are very similar to that which
was reported between the Progressive Matrices and the
Binet tests.  Burke (1958) in his review cites  re-
ported correlations of .75 and .74 with full scale
scores on the Wechsler tests.  McLeod and Rubin (1962)
found significant correlations between the WAIS and the
Progressive Matrices of .58 on the verbal scale; .68
on the performance scale and .67 on the full scale score.
In a later study Purl and Curtis (1971) report corre-
lations between the Matrices and the WISC subscales

of .45, .60, and .58.

Studies conducted by MacArthur (1968-b) suggest a positive relationship between the Progressive Matrices and certain other group tests of mental ability. These include the Safran Culture-Reduced Intelligence Test, Cattell test of "g" Scale 2, and some sub-tests of the Lorge-Thorndike nonverbal Intelligence Tests.

IV. PROGRESSIVE MATRICES:
CONCURRENT AND PREDICTIVE VALIDITY

Up until 1958 the available correlation data indicate  fairly good concurrent and predictive validity for the Progressive Matrices (Burke, 1958). In more recent studies West and MacArthur (1964) and MacArthur (1968-b) report that the Progressive Matrices shows a moderate relationship with concurrent school achievement. Burke (1958) also found abundant evidence of concurrent validity for the Progressive Matrices. He found that it was able to discriminate over a wide range of groups which differed in intellectual capacity as determined by a variety of criteria. Rattan (1966) in his studies of Canadian natives noted a moderate relationship between the Progressive Matrices and current school achievement. Giles (1964) also found the test to have a consistently high validity correlation with achievement criteria.

## V. PROGRESSIVE MATRICES: RELIABILITY

While Burke concluded that the Progressive
Matrices does not have a convincingly high coeffi-
cient of reliability, Foulds and Raven (1948) report
figures of .93 for late teens while Raven (1940)
claims a reliability of .88 for children. Since Burke
came to his conclusion Rattan and MacArthur (1968) have
found the test to be acceptably reliable over three and
four year periods and West (1962) found it to be more
stable than conventional tests over a five year period.
These results reaffirmed Olson's (1962) observation that
the Progressive Matrices tended to be fairly constant
over a four year period. Elley (1961) claims that the
instrument produces results that are at least as stable,
if not more so than an intelligence quotient obtained
from the California Test of Mental Maturity.

## VI. PROGRESSIVE MATRICES:  NORMS

Percentile norms are provided for the Progressive
Matrices for each half-year interval between eight and
fourteen years. No norms are available for the years
between 14 and 20. This in itself limits its use with
a large proportion of junior high school students. The
available norms are based on British samples of 1,407
children, 1,680 military personnel (male) and 2,192
civilian adults. Use of the test in several European

countries suggests that existing norms are adequate. Studies in a number of non-European cultures, however, have raised doubts about the suitability of existing norms for groups with backgrounds differing from the original normative sample (Anastasi, 1968; Green and Ewert, 1955).

A number of authors have cautioned against using the existing norms in a North American urban setting (Anastasi, 1968; Westby, 1953). Raven himself suggests that his sample of children might have been of lower average intelligence than would have been found in large urban settings (Green and Ewert, 1955). Burke (1958) and Magary (1967) also question the legitimacy of applying Raven's norms to different populations.

In a more general frame of reference Westby, (1953); MacArthur, (1965); Rattan and MacArthur, (1968) and Wechsler (1960) all point out the possible errors that might result in applying a set of norms developed on one population to a second, perhaps distinctly different, population. Anastasi (1968) reinforces this position when she points out the value of developing standardized norms for more narrowly defined populations.

Cronbach (1960) notes that norms quickly become obsolete due to an increasing level of education and on-going social change. He further points out that the most useful norms are those that permit the comparison

of an individual with his companions and competitors.
Cronbach (1960) also suggests that the only fair basis
for comparing schools is to judge each school against
schools with similar organization, similar curricula,
and similar promotion policies. He feels that pub-
lished norms are rarely based on meaningful population
segments.

Westby (1953) suggests that perhaps the log-
ical procedure for the use of the Raven, and indeed for
any testing program, is to construct norms regional to
the population for which the instrument is being utilized.
He feels, and this is also implied by Raven, that there
are pitfalls in drawing conclusions from norms which
have been constructed other than on the specific pop-
ulation in question. MacArthur (1965) emphasizes this
point when he explains that a testing instrument must
have appropriate norms or be amenable to the production
of norms. Rattan and MacArthur (1968) further suggest
that because conditions vary so much from one area to
another that there could be an equal variance in pre-
dictive validity on specific instruments. It can be
seen from the foregoing that most assessment instru-
ments, if they are to remain viable, demand on-going
and long term research in the areas outlined.

## VII.  CONCLUSION

In conclusion, it appears that the bulk of the available literature suggests that the Progressive Matrices has acceptable validity and reliability as a test of present intellectual functioning.  Its increasing utilization with Canadian native populations reaffirms it as a culture-reduced test which is easily and efficiently administered and scored.  It is questionable, however, if the norms developed by Raven would be applicable to children in a North American Urban setting.

CHAPTER IV

METHODOLOGY  AND EXPERIMENTAL DESIGN

The primary purpose of this research project
was to develop a table of norms on the Progressive
Matrices that would be applicable for use with the junior
high school students in the Edmonton Separate School
System.  Based on the comments of Raven (1940), Green
and Ewert (1955) and Anastasi (1968) it was hypothe-
sized that the students in the current study would con-
sistently score higher than those in the Raven study.
Hypothesis I stated operationally was:

$H_1$  *The two distributions did not arise,*
*through random sampling, from the*
*same population.*

Hypothesis I stated in the null form was:

$H_0$  *The two distributions arose by*
*random sampling from the same*
*population.*

A related but secondary objective was to con-
duct two validation studies.  The first of these was
between the results obtained by the grade seven students
on the Progressive Matrices and the results they obtained
six months previously on standardized reading and
arithmetic achievement tests.  The second validation

study was between the results obtained by the grade eight students on the Progressive Matrices and on the Canadian Lorge-Thorndike Intelligence Test. The two tests were written within three months of each other.

A third objective of the study was to note the relationship between the results obtained on the Progressive Matrices and the socio-economic status of the students. Based on the foregoing literature review it was postulated that socio-economic status would have only a minimal effect on students' performance on the Progressive Matrices.

The fourth objective of the study was to examine the Progressive Matrices in a cross cultural setting. The purpose of this aspect of the project was to determine if there was a significant difference between the scores obtained on the Progressive Matrices by a sample of native students and the scores obtained by the non-native sample. It was assumed that because of the reputed culture-reduced aspect of the Progressive Matrices that there would not be a significant difference between the two groups.

## I. SAMPLE

The subjects used in this study were selected essentially from the grade seven, eight and nine student population of a large, state-supported urban

school system. The school system has a total enrollment of slightly in excess of thirty thousand pupils. The sample, although selected by age, included approximately ten percent of the students in each junior high school (grade seven, eight and nine) in each of the twenty-nine schools in the system which has junior high school students. The subjects in each school and in each grade were randomly selected from the alphabetically arranged grade lists using a standard table of random numbers (Lordahl, 1967).

A total of 764 students was involved in the development of the age norms while 736 students were involved in the development of the grade norms. A small number of twelve year old students in grade six and fourteen year old students in grade ten were also selected. A two level sampling procedure as suggested by Lord (1959) was utilized in the selection of the grade six and grade ten students.

The majority of the population of native students in the twenty-nine junior high schools visited made up the native sample used in the study. One hundred and six native students were involved.

## II.   INSTRUMENTS

### A.   *Raven Progressive Matrices*

The Progressive Matrices is a nonverbal, culture-reduced test which measures a person's capacity to form comparisons, to reason by analogy and to think logically regardless of previously acquired information (Westby, 1953).  It is reputed to be a measure of general intellectual ability (Burke, 1958; MacArthur,1965; Vernon, 1947; Vincent, 1952).

### B.   *Canadian Lorge-Thorndike Intelligence Test*

The Canadian Lorge-Thorndike Intelligence Test was the criterion with which the grade eight Progressive Matrices was validated.  It consists of a series of tests of abstract intelligence which is designed to measure an individual's ability to work with ideas and to form or identify relationships among ideas.  The test consists of a verbal and a nonverbal battery.  The verbal battery is made up of five subtests: Vocabulary, Sentence Completion, Verbal Classification, Verbal Analogy and Arithmetic Reasoning.  The nonverbal battery consists of Figure Analogies, Figure Classification, and Numerical Relationships.  Wright, Thorndike and Hagen (1972), claim that the two batteries involve tasks that consist of the following types of intelligent behavior:

1. dealing with abstract concepts

2. interpretation and application of symbols

3. forming relationships between concepts and symbols

4. flexibility in the organization of concepts and symbols

Nyberg (1969) reports a reliability of 0.85 for both the verbal and nonverbal batteries.  He also notes that the Canadian Lorge-Thorndike compares favorably with other tests in predicting academic achievement of Edmonton Separate School children.  Churchill and Smith (1966) report a validity coefficient between the Stanford-Binet form L-M and the Lorge-Thorndike verbal and nonverbal batteries of 0.79 and 0.65 respectively. They also found correlations of 0.84 and 0.65 between the Lorge-Thorndike verbal and nonverbal sections and the sixth grade Iowa Test of Basic Skills.  Neufeld (1973) reports significant correlations between the Wechsler Intelligence Scale for Children and the Lorge-Thorndike of 0.74.  While she did not find much communality between any of the subtests she did conclude that either test could be used to obtain an "over-all" intelligence score.

C.  *Standardized Achievement Tests*

The two standardized achievement tests which

were utilized as the criteria in validating the grade
seven Progressive Matrices were the Gates MacGinitie
Reading Test - Survey D (Gates & MacGinitie, 1965) and
the Wisconsin Contemporary Test of Elementary Mathematics
(DeVault, Fennema, Neufeld & Smith, 1968).  These two
tests are given to all grade six students in the
Edmonton Separate School System as part of their reg-
ular testing program.  The mathematics test has re-
ported measures of internal consistency ranging from
0.88 to 0.91 and a validity coefficient of 0.75.  No
evidence of validity measures is available for the
reading test however alternate form and split-half re-
liability ranging from 0.78 to 0.89 are reported.

D.  *Blishen Index*

Socio-economic status was determined through
the use of the Blishen Index (1968).  This instrument
produces what is considered to be an acceptable measure
of socio-economic status in Canada (Olson, 1962).
Blishen (1958) reports a mean correlation of 0.85 be-
tween his Canadian index and similar scales standarized
in Great Britain, New Zealand, Japan and Germany.  A
slightly higher correlation of 0.94 was noted with the
National Opinions Research Centre Index developed by
Hatt (1953).

The socio-economic status of a household is

normally determined by recording the occupation of the father and comparing it to the index as developed by Blishen. Where there was no father in the home the mother's occupation was noted.

### III. DATA COLLECTION

All of the principals of the twenty-nine schools were contacted and their co-operation obtained for the selection and testing of their junior high school students. The selected subjects were tested in groups of from nine to thirty students depending on the school size. The group method of test administration has been reported previously and found to be reliable with no significant differences between group and individual scores (Green and Ewert, 1955). Selected students who were absent during the initial testing were tested on a return visit to the school. Those students who had moved from the school were not replaced through further selection. A total of forty nine students who were selected were thus not included in the study.

Each student was seated at an individual desk and provided with an individual test booklet and a separate answer sheet (Appendix I). Standardized instructions were given as outlined in the Guide to the Progressive Matrices sets A B C D and E (Raven, 1938). A maximum time period of one hour was allocated

for completion of the test.

### IV.   DATA ANALYSIS

All the data were analysed using the 360/67 Computer at the University of Alberta.  The preliminary analysis of the Progressive Matrices results showed by six month intervals and by grade: the number of children tested, the range of scores, the mean score, the standard deviation and the variance.  The raw scores obtained were converted to percentiles using computer program *SPSS (Statistical Package for the Social Sciences).  The percentile norms for the raw scores were listed by age and also by school grade. These were compared to Raven's percentiles using a Kolmogorov-Smirnov Test of Goodness of Fit (Guilford, 1965) and the relationships noted.  A third table of norms was developed by converting the age percentiles into deviation intelligence scores.  Finally a measure of internal consistency was calculated using the Kuder-Richardson formula 20 (Ferguson, 1966).  In the second part of the study the Progressive Matrices raw scores obtained by the grade eight students were compared with their results on the Canadian Lorge-Thorndike Test by computing a Pearson Product-moment correlation coefficient.  In like manner, the raw scores obtained by the grade seven students on the Progressive Matrices were

compared to their results on the Gates MacGinitie
Reading Survey and on the Wisconsin Contemporary Test
of Elementary Mathematics. A third correlational study
was conducted comparing the raw scores obtained by all
students on the Progressive Matrices and their socio-
economic status as measured by the Blishen Index. All
correlation coefficients were calculated using computer
program DESTO 5.

The final aspect of the study examined the dif-
ferences, if any, between the performance of the native
and the non-native subjects on the Progressive Matrices.
This was accomplished by calculating the level of sig-
nificance of the difference between two means for inde-
pendent samples as outlined in Ferguson (1966). A
two-tailed test was employed.

# CHAPTER V

## RESULTS AND CONCLUSIONS

### I. NORMS

The research reported here deals with four sali-
ent aspects of the Raven Standard Progressive Matrices
Intelligence Test: normative data of the matrices, val-
idation of the matrices, socio-economic status and the
matrices, and cross-cultural testing with the matrices.
This chapter reports the results and conclusions of the
research conducted while the following chapter deals with
the implications of these results and the recommendations
stemming from the results. As stated in chapter four the
primary purpose of this project was to develop norms for
the Progressive Matrices that would be applicable for
use with the junior high school students, that is, those
students in grades seven, eight and nine in the Edmonton
Separate School System. These students cover a chronolog-
ical range from approximately twelve to fifteen years in
age. Three tables of norms have been developed:

Table I: *Grade norms for seven, eight and nine
expressed in percentiles*

Table II: *Age norms for twelve, thirteen, and fourteen
expressed in percentiles*

Table III: *Age norms for twelve, thirteen, and fourteen
expressed as deviation intelligence scores with
a mean of 100 and a standard deviation of 15.*

TABLE   I

*Percentile Norms For*

*Grades Seven, Eight and Nine*

| Raw Score | Grade 7 | Grade 8 | Grade 9 |
|---|---|---|---|
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | 1 | — | — |
| 24 | 1 | — | — |
| 25 | 2 | — | — |
| 26 | 3 | — | — |
| 27 | 3 | — | — |
| 28 | 3 | 1 | 1 |
| 29 | 4 | 2 | 1 |
| 30 | 4 | 2 | 1 |
| 31 | 7 | 2 | 1 |
| 32 | 9 | 2 | 1 |
| 33 | 10 | 4 | 2 |
| 34 | 12 | 4 | 4 |
| 35 | 13 | 5 | 4 |
| 36 | 16 | 7 | 6 |
| 37 | 19 | 8 | 6 |
| 38 | 20 | 9 | 7 |
| 39 | 24 | 11 | 10 |
| 40 | 27 | 15 | 11 |
| 41 | 32 | 20 | 15 |
| 42 | 38 | 24 | 17 |
| 43 | 44 | 31 | 23 |
| 44 | 50 | 37 | 28 |
| 45 | 60 | 41 | 33 |
| 46 | 64 | 49 | 38 |
| 47 | 70 | 53 | 45 |
| 48 | 76 | 60 | 52 |
| 49 | 82 | 67 | 60 |
| 50 | 86 | 75 | 68 |
| 51 | 90 | 80 | 73 |
| 52 | 95 | 86 | 79 |
| 53 | 97 | 90 | 84 |
| 54 | 98 | 95 | 90 |
| 55 | 99 | 99 | 95 |
| 56 | 99 | 99 | 98 |
| 57 | — | — | 99 |
| 58 | — | — | 99 |
| 59 | — | — | — |
| 60 | — | — | — |

TABLE II

*Percentile Norms For*

*Ages Twelve, Thirteen and Fourteen*

| Raw Score | Chronological Age | | | | | |
|---|---|---|---|---|---|---|
| | 12-0 12-5 | 12-6 12-11 | 13-0 13-5 | 13-6 13-11 | 14-0 14-5 | 14-6 14-11 |
| 20 | | | | | | |
| 21 | | | | | | |
| 22 | | | | | | |
| 23 | 1 | – | – | – | – | – |
| 24 | 1 | – | – | – | – | – |
| 25 | 1 | – | – | 1 | – | 3 |
| 26 | 2 | 1 | – | 1 | – | 3 |
| 27 | 3 | 2 | 1 | 1 | – | 3 |
| 28 | 3 | 2 | 1 | 2 | – | 4 |
| 29 | 3 | 2 | 1 | 3 | – | 4 |
| 30 | 4 | 2 | 2 | 3 | 1 | 4 |
| 31 | 7 | 3 | 2 | 3 | 1 | 4 |
| 32 | 8 | 6 | 3 | 3 | 2 | 5 |
| 33 | 10 | 8 | 3 | 4 | 2 | 6 |
| 34 | 12 | 8 | 4 | 6 | 4 | 8 |
| 35 | 14 | 9 | 5 | 6 | 5 | 8 |
| 36 | 15 | 11 | 9 | 7 | 6 | 9 |
| 37 | 18 | 12 | 11 | 88 | 8 | 10 |
| 38 | 20 | 14 | 13 | 10 | 8 | 10 |
| 39 | 24 | 16 | 15 | 11 | 14 | 11 |
| 40 | 26 | 21 | 21 | 13 | 18 | 12 |
| 41 | 31 | 26 | 24 | 15 | 25 | 13 |
| 42 | 37 | 32 | 28 | 20 | 28 | 14 |
| 43 | 42 | 38 | 37 | 25 | 34 | 22 |
| 44 | 47 | 45 | 44 | 30 | 38 | 26 |
| 45 | 58 | 52 | 48 | 36 | 41 | 33 |
| 46 | 61 | 57 | 55 | 44 | 43 | 41 |
| 47 | 70 | 62 | 59 | 48 | 48 | 47 |
| 48 | 77 | 70 | 63 | 55 | 54 | 55 |
| 49 | 82 | 79 | 67 | 64 | 62 | 62 |
| 50 | 86 | 82 | 77 | 71 | 69 | 69 |
| 51 | 90 | 87 | 84 | 73 | 74 | 74 |
| 52 | 96 | 91 | 87 | 81 | 80 | 80 |
| 53 | 97 | 94 | 92 | 86 | 84 | 84 |
| 54 | 99 | 98 | 97 | 91 | 90 | 90 |
| 55 | 99 | 99 | 99 | 98 | 94 | 94 |
| 56 | 99 | 99 | 99 | 99 | 98 | 95 |
| 57 | – | – | – | – | 98 | 98 |
| 58 | – | – | – | – | 99 | 99 |
| 59 | – | – | – | – | – | – |
| 60 | – | – | – | – | – | – |

# TABLE   III

*Deviation Intelligence Scores for*

*Ages Twelve, Thirteen and Fourteen*

| Raw Score | Chronological Age | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | 12-0 12-5 | 12-6 12-11 | 13-0 13-5 | 13-6 13-11 | 14-0 14-5 | 14-6 14-11 |
| 20 | – | – | – | – | – | – |
| 21 | – | – | – | – | – | – |
| 22 | – | – | – | – | – | – |
| 23 | 66 | – | – | – | – | – |
| 24 | 66 | – | – | – | – | – |
| 25 | 66 | – | – | – | – | – |
| 26 | 69 | 66 | – | – | – | – |
| 27 | 72 | 69 | 66 | 66 | – | – |
| 28 | 72 | 69 | 66 | 69 | – | – |
| 29 | 72 | 69 | 66 | 72 | – | – |
| 30 | 74 | 69 | 69 | 72 | 66 | – |
| 31 | 78 | 72 | 69 | 72 | 66 | – |
| 32 | 79 | 77 | 72 | 72 | 69 | – |
| 33 | 81 | 79 | 72 | 74 | 69 | – |
| 34 | 83 | 69 | 74 | 77 | 74 | – |
| 35 | 84 | 80 | 75 | 77 | 75 | – |
| 36 | 84 | 82 | 80 | 78 | 77 | – |
| 37 | 86 | 83 | 82 | 79 | 79 | 81 |
| 38 | 87 | 84 | 83 | 81 | 79 | 81 |
| 39 | 89 | 85 | 84 | 82 | 84 | 82 |
| 40 | 90 | 88 | 88 | 83 | 86 | 83 |
| 41 | 97 | 90 | 89 | 84 | 90 | 83 |
| 42 | 97 | 92 | 91 | 87 | 91 | 84 |
| 43 | 99 | 95 | 97 | 90 | 94 | 84 |
| 44 | 103 | 98 | 98 | 92 | 95 | 90 |
| 45 | 104 | 101 | 99 | 95 | 97 | 93 |
| 46 | 106 | 103 | 102 | 98 | 97 | 97 |
| 47 | 108 | 105 | 104 | 99 | 99 | 99 |
| 48 | 111 | 108 | 105 | 102 | 101 | 102 |
| 49 | 114 | 112 | 107 | 105 | 105 | 105 |
| 50 | 116 | 114 | 111 | 108 | 108 | 108 |
| 51 | 119 | 117 | 115 | 109 | 110 | 110 |
| 52 | 126 | 120 | 117 | 113 | 113 | 113 |
| 53 | 128 | 123 | 121 | 116 | 115 | 115 |
| 54 | 135 | 131 | 128 | 120 | 119 | 119 |
| 55 | 135 | 135 | 135 | 131 | 123 | 123 |
| 56 | 135 | 135 | 135 | 135 | 131 | 125 |
| 57 | – | – | – | – | 131 | 131 |
| 58 | – | – | – | – | 135 | 135 |
| 59 | – | – | – | – | 135 | 135 |
| 60 | – | – | – | – | – | – |

Measures of variability were calculated for the grade scores and for the age scores. The number of subjects, mean, range, standard deviation and variances of the grade scores are recorded in Table IV.

A measure of internal consistency was also calculated for the Progressive Matrices at each grade level using a Kuder-Richardson formula 20 (Ferguson, 1966). A K-R 20 reliability coefficient of 0.86 was obtained at the grade seven level; 0.82 at the grade eight level; and 0.88 at the grade nine level. Based on guidelines outlined by Guilford (1965) these figures which are also shown in Table IV suggest that the Progressive Matrices has acceptable reliability. These figures also compare favorably to those reported earlier in this study by Elley (1961), Foulds and Raven (1948) and Rattan and MacArthur (1968).

TABLE IV

*Grade Norms  Variability*

| Grade | N | Mean | Range | S.D. | Variance | K-R 20 |
|-------|-----|-------|-------|------|----------|--------|
| 7 | 249 | 43.33 | 44 | 7.12 | 50.71 | 0.86 |
| 8 | 248 | 46.23 | 38 | 6.01 | 36.09 | 0.82 |
| 9 | 239 | 47.34 | 46 | 6.58 | 43.26 | 0.88 |

In like manner the number of subjects, mean, range, standard deviation and variance of the age scores are summarized in Table V.

TABLE   V

*Age Norms Variability*

| Age | N | Mean | Range | S.D. | Variance |
|-----|---|------|-------|------|----------|
| 12-0 }<br>12-5 | 137 | 43.59 | 34 | 6.72 | 45.17 |
| 12-6<br>    }<br>12-11 | 108 | 44.60 | 44 | 6.72 | 45.20 |
| 13-0<br>    }<br>13-5 | 119 | 45.53 | 28 | 5.95 | 35.44 |
| 13-6<br>    }<br>13-11 | 123 | 46.81 | 38 | 6.53 | 42.62 |
| 14-0<br>    }<br>14-5 | 133 | 46.65 | 45 | 6.75 | 45.48 |
| 14-6<br>    }<br>14-11 | 144 | 46.81 | 46 | 7.68 | 58.91 |

A comparison was made between the age norms re-
ported by Raven (1938) and the norms developed in this
study.   This comparison is charted in Figures IV,V, and
VI for ages twelve, thirteen and fourteen respectively.
Examination of the figures shows that Raven's norms
essentially parallel the norms developed in this project.
Use of the Raven norms however, consistently results in
a higher percentile placement.   This difference ranges
as high as 26.8 percentile points.
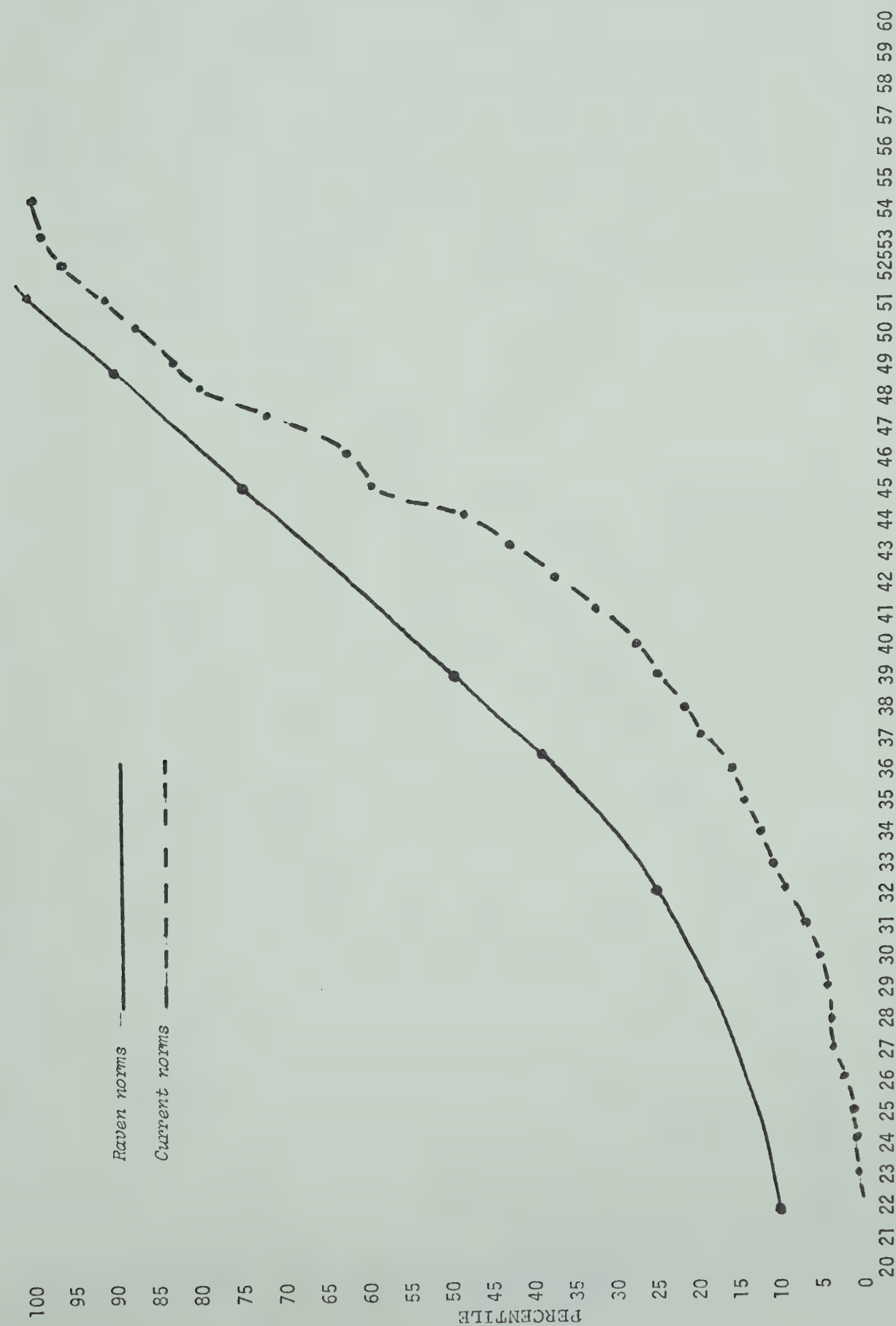
Figure IV.    Comparison of Raven Norms

With Current Norms: Age 12
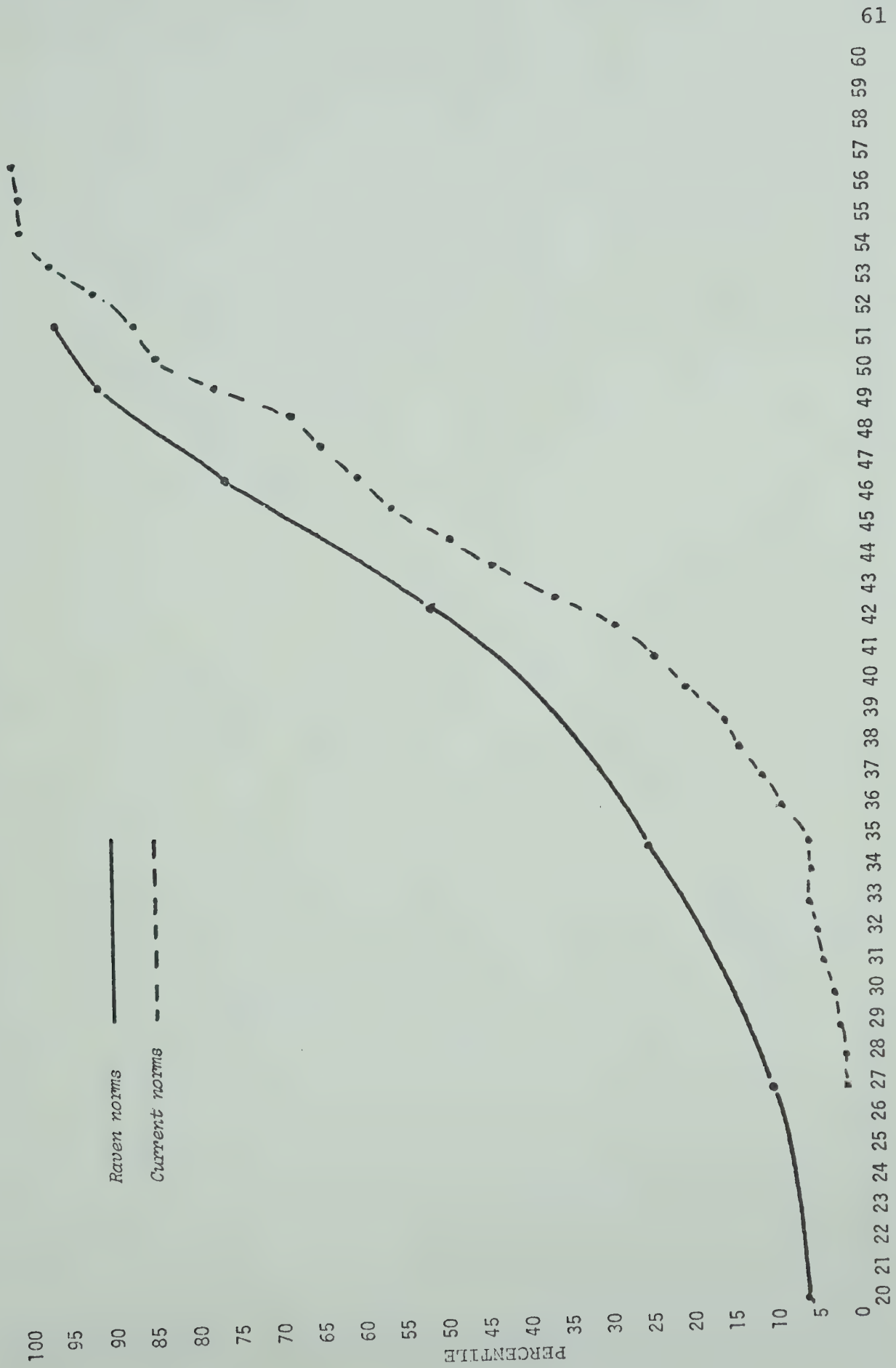
Figure V.   Comparison of Raven Norms
With Current Norms: Age 13
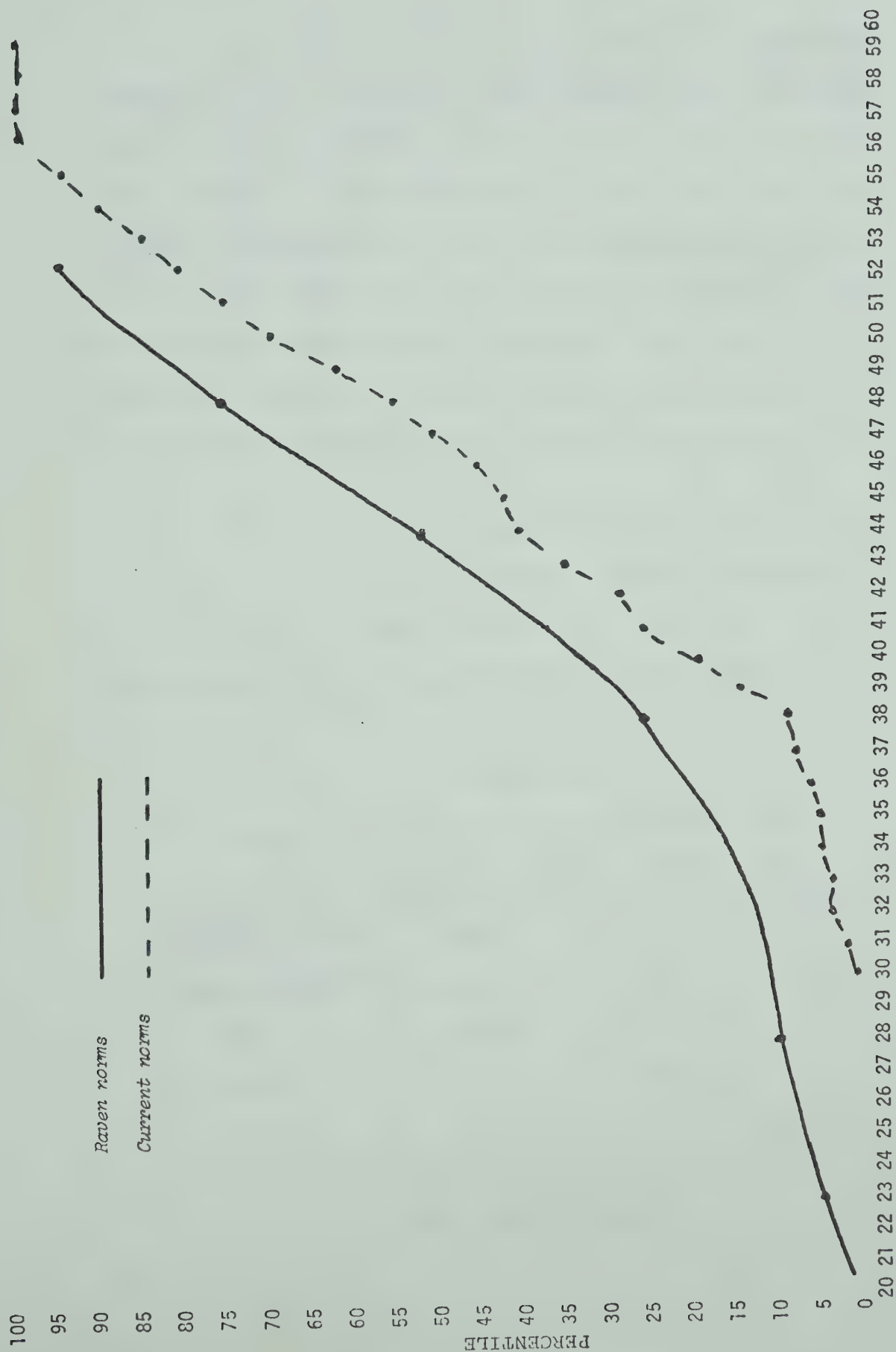
Figure VI.   Comparison of Raven Norms
With Current Norms: Age 14

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In order to assess the degree of difference between the two frequency distributions the Kolmogorov-Smirnov Test of Goodness of Fit was applied (Guilford, 1965). Using a one-tailed test it was found that the differences between the two distributions were significant at the 0.001 level for the grade seven and eight students and significant at the 0.01 level for the grade nine students. These results which are summarized in Table VI necessitated acceptance of Hypothesis I:

$H_1$     *The two distributions did not arise, through random sampling, from the same population.*

Conversely, the null hypothesis was rejected.

TABLE VI

*Kolmogorov-Smirnov Test of Goodness of Fit
Between Current Norms and Raven Norms*

| Current norms / Raven Norms | Grade 7 | Grade 8 | Grade 9 |
|---|---|---|---|
| Grade 7 | 33.44* | | |
| Grade 8 | | 17.55* | |
| Grade 9 | | | 13.61** |

\* *Sig. at* $p \leq 0.001$
\*\* *Sig. at* $p \leq 0.01$

## II. VALIDATION OF THE MATRICES

In the second part of this study measures of concurrent and construct validity were calculated for the Progressive Matrices. The Gates MacGinitie Reading Test-Survey D and the Wisconsin Contemporary Test of Elementary Mathematics were used as the criteria for assessing concurrent validity. A Pearson product-moment correlation coefficient of r=0.45 was noted between the Matrices and the reading test. In like manner an r=0.59 was recorded between the Matrices and the mathematics test. Both correlations are considered significant.

These results show that the Progressive Matrices has acceptable concurrent validity (Guilford, 1965). This conclusion is consistent with those reported by Burke (1958), MacArthur (1968-b) and West and MacArthur (1964). The higher correlation noted between the Progressive Matrices and the mathematics scores can be explained by the highly analytic nature of the tasks involved.(Carlson, 1973; Rimoldi, 1948). This is opposed to the essentially verbal stimuli tasks that are involved in reading. A similar inference was made by Blumenkrantz et al (1968) when they stated:

> *It is to be expected that P.M., a*
> *nonverbal measure, should correlate*
> *somewhat lower with Reading and*
> *Vocabulary.* (p. 933)

The criteria used in calculating construct validity measures were the verbal and nonverbal batteries of the Canadian Lorge-Thorndike Intelligence Scale. Using the procedure noted above an r=0.34 was found between the Matrices and the verbal scale while an r=0.61 was found between the Matrices and the nonverbal scale.

The correlation coefficient of 0.61 between the Progressive Matrices and the nonverbal battery is similar to the correlations reported by McLeod and Rubin (1962) between the Matrices and the performance scale of the WAIS. The same authors however report markedly higher correlation between the Matrices and the verbal scale of the Wechsler test than the 0.34 found between the Matrices and the verbal test used in this study. This lower correlation can be explained by the major emphasis in the Lorge-Thorndike on past, formal, verbal learning i.e. cultural and environmental factors involved in formal education. It is suggested that this is much more pronounced in the Lorge-Thorndike than in the Wechsler Tests. This results therefore in a lower correlation between a culture-loaded test such as the Lorge-Thorndike and a culture reduced test such as the Progressive Matrices.

Notwithstanding the foregoing the reported correlations between the Progressive Matrices and the Lorge-Thorndike, particularly the nonverbal battery,

lends credence to the construct validity of the Matrices.
This conclusion is in essential agreement with the con-
clusion drawn in chapter three regarding the test's
construct validity.  The correlations calculated are
summarized in Table VII.

TABLE   VII

*Pearson Product-Moment Correlations*

*Between the Progressive Matrices*

*And the   Validation Criteria*

|  | Reading | Mathematics | CL-T Verbal | CL-T N.Verbal |
|---|---|---|---|---|
| P.M. | 0.45 | 0.59 | 0.34 | 0.61 |

III.  SOCIO-ECONOMIC STATUS AND THE MATRICES

The third section of this project examined the
relationship between the Progressive Matrices and the
socio-economic status of the students by calculating a
Pearson product-moment correlation coefficient.  A
significant correlation was found to exist between the
Progressive Matrices and socio-economic status for the
grade seven and eight students but not for the grade
nine students.  These results are summarized in Table
VIII.

TABLE VIII

*Pearson Product-Moment correlations*

*Between*

*The Progressive Matrices and the Blishen Index*

|  | P.M. Grd. 7 | P.M. Grd. 8 | P.M. Grd.9 |
|---|---|---|---|
| Blishen | 0.16 | 0.30 | 0.00 |

While significant correlations were noted be-
tween the Progressive Matrices and the socio-economic
status for both the grade seven and eight students these
are not considered to be substantive.  That is, the fig-
ures of r=0.16 and r=0.30, particularly the former, are
small enough to be considered unimportant.  Because of
the comparatively large numbers involved in the study
it would have been highly unlikely if a significant cor-
relation did not exist.  For practical purposes there-
fore it can be assumed that performance on the Progressive
Matrices is not appreciably affected by socio-economic
status.

The above conclusion is reinforced by the non-
significant correlation calculated between the socio-
economic status of the grade nine students and their
scores on the Progressive Matrices.  The foregoing ob-
servations lend further support to the reported litera-
ture which suggests that the Matrices test is in fact one
which is minimally affected by cultural and environ-

mental influences.

IV. CROSS CULTURAL TESTING AND THE MATRICES

The final objective of this project was to examine the Progressive Matrices in a cross-cultural setting to determine if a significant difference existed between the performance of a native (Canadian Indian) and a non-native sample of students. Using a t-test to determine the significance of difference between two means for independent samples (Ferguson, 1959) it was found that a significant difference did exist between the two populations at the grade seven and eight levels. No significant difference existed at the grade nine level. These findings are summarized in Table IX.

TABLE IX

*Significance of Differences*

*Between Two Means*

*For Independent Samples*

|  | Gr. 7 Non-native | Gr. 8 Non-native | Gr. 9 Non-native |
|---|---|---|---|
| Gr. 7 native | 3.25* | | |
| Gr. 8 native | | 2.92* | |
| Gr. 9 native | | | 0.82 |

*\* Sig. at p $\leq$ .01*

An F test was also conducted to determine if there was a significant difference between the variances of the independent samples i.e. the native and the non-native samples (Ferguson, 1966). As noted in Table X no significant differences were found at the 10% level of confidence which lends further credence to the significant levels noted in Table IX.

TABLE  X

*Significance  of Differences*

*Between*

*Variances of Independent Samples*

|  | Gr. 7 Non-Native | Gr. 8 Non-Native | Gr. 9 Non-Native |
|---|---|---|---|
| Gr. 7 Native | 1.28 (F=2.92)* | | |
| Gr. 8 Native | | 1.55 (F=3.04)* | |
| Gr. 9 Native | | | 1.71 (F=3.14)* |

* Critical value of  F

The above findings are contrary to the assumption made in chapter IV i.e. that there would not be a significant difference between the native and the non-native samples. A number of tentative explanations or assumptions are put forth in the following chapter which might account for these findings.

# CHAPTER VI

## IMPLICATIONS AND RECOMMENDATIONS

### I.   IMPLICATIONS

A. *Norms*

Based on the tripartite thinking that:

(a) the available norms on the Progressive Matrices
are relatively incomplete

(b) test norms tend towards early obsolescence

(c) there is an inherent danger in applying a set
of norms developed on one population to a second,
perhaps distinctly different population

new norms were developed on the Progressive Matrices for
use with the grade seven, eight and nine students in the
Edmonton Separate School System.  The findings show that
the norms developed in the current study differ signif-
icantly from those developed by Raven.  The current
norms are significantly higher than the English norms.

This research also lends credence to the be-
lief stated in chapter three that norms, if they are to
be meaningful, should be developed on the population to
which they are to be applied.  These findings further
justify the need for this and similar types of norming
projects.

B. *Validation*

The significant correlation coefficients ob-

tained between the Progressive Matrices and both the standardized tests of mathematics and reading show, using Guilford's (1965) rationale, that the Matrices has acceptable concurrent validity. This observation corresponds to one made by Kerr (1972) in which he noted that the Progressive Matrices shows promise as a discriminator of academic achievement. Relating the above to Cronbach's (1960) suggestion that concurrent and predictive validity are essentially the same concepts it is concluded that the probability is high that the Progressive Matrices has predictive validity in the areas of reading and mathematics.

The above would appear to be particularly true if the Progressive Matrices was utilized in conjunction with a vocabularly test as was originally suggested by Foulds and Raven (1948) and by Raven (1938). This would perhaps compensate for the tendency of the Matrices to correlate lower with verbal test batteries than with non-verbal test batteries as was noted both in this study and in the study reported by McLeod and Rubin (1962).

## C. *Cross Cultural Testing*

Contrary to the assumption made in chapter four, significant differences were found between the performance of the native and the non-native students at the grade seven and eight levels. A number of tentative

explanations can be put forth which might account for
these findings. Initially it can be assumed that the
nonsignificant difference at the grade nine level is due
to the tendency of the native students to leave school.
It is generally accepted that it is the "brighter"
students who remain in school. This then would tend to
reduce or counteract the effects of the different environ-
mental and cultural backgrounds of the two groups which
existed prior to grade nine.

A second assumption put forth to explain the
significant differences is that the two groups come from
markedly different environmental backgrounds and that
the Progressive Matrices was unable to effectively re-
duce the effects of such influences. Such an assumption
however, is not in keeping with the reported literature
nor with the observations reported above which showed
that the Progressive Matrices was essentially not
affected by socio-economic status.

A third assumption, which is closely connected
to the second, deals with the motivational and attitudin-
al factors that the native students bring to bear or
perhaps more accurately, fail to bring to bear, on the
writing of a test. If the native students are not moti-
vated to do well on the test or if they have a highly
impulsive response style they will score much below the
highly motivated-reflective student (Kagan, 1971). A

culture-reduced test however should take these factors, at least to some degree, into account.

A final and highly controversial assumption stems from the work of Jensen (1959). If one accepts Jensen's theories and if one accepts the meaning of intelligence as is traditionally used in the white European-American context it might be hypothesized that there are genetically based differences in intelligence and/or in methods of information processing between the native and non-native samples.

## II.  RECOMMENDATIONS

The above assumptions point out a number of shortcomings in the present study. These shortcomings in turn generate a number of suggestions for future research. Initially it appears necessary to determine to what extent the Progressive Matrices is culture-reduced. By comparing the results of a series of intelligence tests given concurrently to a native population it would be possible to calculate the extent to which the Progressive Matrices reduces the effect of cultural influences as compared to other tests. In this regard also it seems vital to compare the performance of a number of other sub-cultures on the Progressive Matrices. If there is a significant difference between each sub-culture and the total population it can be assumed that the Progressive Matrices is not a culture-reduced test.

In regard to the third assumption it would also appear important to examine the response style of the native subjects. The Progressive Matrices requires a highly reflective approach if one is to achieve a consistent degree of accuracy--impulsivity tends to lead to inaccuracy (Kagan, 1971). The third assumption also suggests that native students might require special or unique teaching programs.Guinagh (1969) points out that native students must be taught different types of learning skills than the non-native students if they are to achieve academically. It is important to determine therefore the skills in which these students are deficient. Future research in this area also should examine the relative importance of the three major factors in learning: previous knowledge, motivation and intelligence (Husen, 1967). If the significant differences between the native and the non-native groups are due to either a deficiency in previous knowledge or in motivation one would have to question if the Progressive Matrices is culture reduced. Such findings would also add strength to the above recommendation made by Guinagh (1969).

In addition to the foregoing it would prove worthwhile to carry out a series of "Jensen-type" experiments. This might help to determine if the native population is capable of "learning" to the same extent

and with the same ease as are non-native students.
Finally such research could perhaps offer educational
suggestions for dealing with any noted differences in ·
learning style.

One of the most obvious recommendations that
arises is that the norms developed in this project
should be utilized with the population in question. To
use the norms developed by Raven would be most mis-
leading and inaccurate. It follows from these findings
that if the Progressive Matrices is to be effectively util-
ized local norms should be developed for each of the
remaining grade and age levels. It is suggested that if
this were to be accomplished that the Progressive
Matrices could become a valuable asset to the local
school systems. The value of the test is further empha-
sized when examined in light of its ease of administration,
adaptability to group testing, relatively small capital
outlay for materials, and its acceptable levels of
reliability and validity.

The study further authenticates Anastasi's
(1968) and Cronbach's (1960) position that norms are
seldom developed on meaningfully specific populations.
It is suggested therefore that where possible local norms
should be developed for most testing instruments. If
this is not possible great caution should be exercised in
interpreting data from broadly based norms.

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APPENDICES

# APPENDIX I

NAME _____
Last          First          Middle

FACULTY
or
SCHOOL _____

AGE _____  YEAR or GRADE _____  ☐ ☐  DATE _____
Years              Male Female      Day  Month  Year

OCCUPATION _____

F _____

2. _____

M

Indicate response by placing a mark between the guidelines as shown in the example.
Use HB pencil. Don't make marks longer than guidelines.

Example

I.D. NUMBER

```
0  1  2  3  4      5  6  7  8  9
0  1  2  3  4      5  6  7  8  9
0  1  2  3  4      5  6  7  8  9
0  1  2  3  4      5  6  7  8  9
0  1  2  3  4      5  6  7  8  9
```

A  0  1  2  3  4      5  6  7  8  9

B

G  0  1  2  3  4      5  6  7  8  9
V  0  1  2  3  4      5  6  7  8  9

M      0  1  2  3  4      5  6  7  8  9
       0  1  2  3  4      5  6  7  8  9

R  NV  0  1  2  3  4      5  6  7  8  9
       0  1  2  3  4      5  6  7  8  9
       0  1  2  3  4      5  6  7  8  9

A

```
 1.  0  1  2  3  4      5  6          7.   0  1  2  3  4      5  6  7  8
 2.  0  1  2  3  4      5  6          8.   0  1  2  3  4      5  6  7  8
 3.  0  1  2  3  4      5  6          9.   0  1  2  3  4      5  6  7  8
 4.  0  1  2  3  4      5  6         10.   0  1  2  3  4      5  6  7  8
 5.  0  1  2  3  4      5  6         11.   0  1  2  3  4      5  6  7  8
 6.  0  1  2  3  4      5  6         12.   0  1  2  3  4      5  6  7  8
 7.  0  1  2  3  4      5  6
 8.  0  1  2  3  4      5  6    D
 9.  0  1  2  3  4      5  6          1.   0  1  2  3  4      5  6  7  8
10.  0  1  2  3  4      5  6          2.   0  1  2  3  4      5  6  7  8
11.  0  1  2  3  4      5  6          3.   0  1  2  3  4      5  6  7  8
12.  0  1  2  3  4      5  6          4.   0  1  2  3  4      5  6  7  8
                                     5.   0  1  2  3  4      5  6  7  8
B                                    6.   0  1  2  3  4      5  6  7  8
 1.  0  1  2  3  4      5  6          7.   0  1  2  3  4      5  6  7  8
 2.  0  1  2  3  4      5  6          8.   0  1  2  3  4      5  6  7  8
 3.  0  1  2  3  4      5  6          9.   0  1  2  3  4      5  6  7  8
 4.  0  1  2  3  4      5  6         10.   0  1  2  3  4      5  6  7  8
 5.  0  1  2  3  4      5  6         11.   0  1  2  3  4      5  6  7  8
 6.  0  1  2  3  4      5  6         12.   0  1  2  3  4      5  6  7  8
 7.  0  1  2  3  4      5  6
 8.  0  1  2  3  4      5  6    E
 9.  0  1  2  3  4      5  6          1.   0  1  2  3  4      5  6  7  8
10.  0  1  2  3  4      5  6          2.   0  1  2  3  4      5  6  7  8
11.  0  1  2  3  4      5  6          3.   0  1  2  3  4      5  6  7  8
12.  0  1  2  3  4      5  6          4.   0  1  2  3  4      5  6  7  8
                                     5.   0  1  2  3  4      5  6  7  8
C                                    6.   0  1  2  3  4      5  6  7  8
 1.  0  1  2  3  4      5  6          7.   0  1  2  3  4      5  6  7  8
 2.  0  1  2  3  4      5  6  7  8    8.   0  1  2  3  4      5  6  7  8
 3.  0  1  2  3  4      5  6  7  8    9.   0  1  2  3  4      5  6  7  8
 4.  0  1  2  3  4      5  6  7  8   10.   0  1  2  3  4      5  6  7  8
 5.  0  1  2  3  4      5  6  7  8   11.   0  1  2  3  4      5  6  7  8
 6.  0  1  2  3  4      5  6  7  8   12.   0  1  2  3  4      5  6  7  8
```

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CAUTION — AVOID FOLDING and MAKING MARKS ALONG THE BLACK TIMING LINES

OVERPRINT ANSWER SHEET

## APPENDIX  II

*Grade Seven Frequency Distribution*

| Frequency | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | | | | | | | | | | | | | | | |
| 54 | | | | | | | | | | * | | | | | |
| 52 | | | | | | | | | | * | | | | | |
| 50 | | | | | | | | | | * | | | | | |
| 48 | | | | | | | | | | * | | | | | |
| 46 | | | | | | | | | | * | | | | | |
| 44 | | | | | | | | | | * | | | | | |
| 42 | | | | | | | | | | * | | | | | |
| 40 | | | | | | | | | | * | * | | | | |
| 38 | | | | | | | | | | * | * | | | | |
| 36 | | | | | | | | | | * | * | | | | |
| 34 | | | | | | | | | * | * | * | | | | |
| 32 | | | | | | | | | * | * | * | * | | | |
| 30 | | | | | | | | | * | * | * | * | | | |
| 28 | | | | | | | | | * | * | * | * | | | |
| 26 | | | | | | | | | * | * | * | * | | | |
| 24 | | | | | | | | | * | * | * | * | | | |
| 22 | | | | | | | | | * | * | * | * | | | |
| 20 | | | | | | | | | * | * | * | * | | | |
| 18 | | | | | | | | * | * | * | * | * | * | | |
| 16 | | | | | | | | * | * | * | * | * | * | | |
| 14 | | | | | | | | * | * | * | * | * | * | | |
| 12 | | | | | | * | * | * | * | * | * | * | * | | |
| 10 | | | | | | * | * | * | * | * | * | * | * | | |
| 8 | | | | | | * | * | * | * | * | * | * | * | | |
| 6 | | | | | | * | * | * | * | * | * | * | * | | |
| 4 | | | | * | | * | * | * | * | * | * | * | * | * | |
| 2 | | | | * | * | * | * | * | * | * | * | * | * | * | |
| Interval ... | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 |

## APPENDIX III

*Grade Eight Frequency Distribution*

| Frequency | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | | | | | | | | | | | | | | | |
| 54 | | | | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | * | | | |
| 48 | | | | | | | | | | | | * | | | |
| 46 | | | | | | | | | | | * | * | | | |
| 44 | | | | | | | | | | | * | * | | | |
| 42 | | | | | | | | | | * | * | * | | | |
| 40 | | | | | | | | | | * | * | * | | | |
| 38 | | | | | | | | | | * | * | * | * | | |
| 36 | | | | | | | | | | * | * | * | * | | |
| 34 | | | | | | | | | | * | * | * | * | | |
| 32 | | | | | | | | | * | * | * | * | * | | |
| 30 | | | | | | | | | * | * | * | * | * | | |
| 28 | | | | | | | | | * | * | * | * | * | | |
| 26 | | | | | | | | | * | * | * | * | * | | |
| 24 | | | | | | | | | * | * | * | * | * | | |
| 22 | | | | | | | | | * | * | * | * | * | | |
| 20 | | | | | | | | | * | * | * | * | * | | |
| 18 | | | | | | | | | * | * | * | * | * | | |
| 16 | | | | | | | | | * | * | * | * | * | | |
| 14 | | | | | | | | | * | * | * | * | * | * | |
| 12 | | | | | | | | * | * | * | * | * | * | * | |
| 10 | | | | | | | | * | * | * | * | * | * | * | |
| 8 | | | | | | | * | * | * | * | * | * | * | * | |
| 6 | | | | | | * | * | * | * | * | * | * | * | * | |
| 4 | | | | | * | * | * | * | * | * | * | * | * | * | |
| 2 | | * | | | * | * | * | * | * | * | * | * | * | * | |

Interval ...  18 21 24 27 30 33 36 39 42 45 48 51 54 57 60

# APPENDIX   IV

## *Grade Nine   Frequency Distribution*

| Frequency | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | | | | | | | | | | | | | | | |
| 54 | | | | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | * | | | |
| 48 | | | | | | | | | | | | * | | | |
| 46 | | | | | | | | | | | | * | | | |
| 44 | | | | | | | | | | | * | * | | | |
| 42 | | | | | | | | | | | * | * | | | |
| 40 | | | | | | | | | | * | * | * | * | | |
| 38 | | | | | | | | | | * | * | * | * | | |
| 36 | | | | | | | | | | * | * | * | * | | |
| 34 | | | | | | | | | | * | * | * | * | | |
| 32 | | | | | | | | | | * | * | * | * | | |
| 30 | | | | | | | | | | * | * | * | * | | |
| 28 | | | | | | | | | | * | * | * | * | | |
| 26 | | | | | | | | | | * | * | * | * | | |
| 24 | | | | | | | | | | * | * | * | * | | |
| 22 | | | | | | | | | | * | * | * | * | | |
| 20 | | | | | | | | | | * | * | * | * | * | |
| 18 | | | | | | | | | | * | * | * | * | * | |
| 16 | | | | | | | | | * | * | * | * | * | * | |
| 14 | | | | | | | | | * | * | * | * | * | * | |
| 12 | | | | | | | | | * | * | * | * | * | * | |
| 10 | | | | | | | * | | * | * | * | * | * | * | |
| 8 | | | | | | | * | * | * | * | * | * | * | * | |
| 6 | | | | | | | * | * | * | * | * | * | * | * | |
| 4 | | | | | | | * | * | * | * | * | * | * | * | |
| 2 | | | | | | * | * | * | * | * | * | * | * | * | * |
| Interval ... | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 |

APPENDIX V-A

*Progressive Matrices*
*Point - Biserial Correlations*
*-Grades Seven Eight and Nine-*

| Test Item | Grade Seven | Grade Eight | Grade Nine |
|-----------|-------------|-------------|------------|
| A 1 | 0.0 | 0.01 | 0.42 |
| A 2 | 0.11 | 0.15 | 0.26 |
| A 3 | 0.09 | 0.13 | 0.11 |
| A 4 | 0.04 | 0.00 | 0.32 |
| A 5 | 0.18 | 0.06 | 0.33 |
| A 6 | 0.10 | 0.10 | 0.26 |
| A 7 | 0.25 | 0.21 | 0.50 |
| A 8 | 0.18 | 0.18 | 0.32 |
| A 9 | 0.25 | 0.21 | 0.27 |
| A10 | 0.21 | 0.32 | 0.38 |
| A11 | 0.42 | 0.37 | 0.40 |
| A12 | 0.50 | 0.29 | 0.30 |
| | | | |
| B 1 | 0.02 | 0.14 | 0.27 |
| B 2 | -0.02 | 0.08 | 0.24 |
| B 3 | 0.29 | 0.21 | 0.42 |
| B 4 | 0.24 | 0.18 | 0.42 |
| B 5 | 0.22 | 0.42 | 0.38 |
| B 6 | 0.33 | 0.30 | 0.37 |
| B 7 | 0.45 | 0.31 | 0.46 |
| B 8 | 0.52 | 0.23 | 0.27 |
| B 9 | 0.45 | 0.29 | 0.41 |
| B10 | 0.50 | 0.31 | 0.40 |
| B11 | 0.44 | 0.37 | 0.37 |
| B12 | 0.51 | 0.42 | 0.43 |

APPENDIX V-B

*Progressive Matrices*
*Point-Biserial   Correlations*
*-Grades Seven Eight and Nine-*

| Test Item | Grade Seven | Grade Eight | Grade Nine |
|-----------|-------------|-------------|------------|
| C 1 | 0.16 | 0.34 | 0.46 |
| C 2 | 0.35 | 0.35 | 0.56 |
| C 3 | 0.43 | 0.25 | 0.37 |
| C 4 | 0.23 | 0.22 | 0.32 |
| C 5 | 0.38 | 0.08 | 0.54 |
| C 6 | 0.38 | 0.44 | 0.39 |
| C 7 | 0.44 | 0.48 | 0.47 |
| C 8 | 0.47 | 0.41 | 0.43 |
| C 9 | 0.35 | 0.29 | 0.28 |
| C10 | 0.45 | 0.43 | 0.44 |
| C11 | 0.36 | 0.36 | 0.31 |
| C12 | 0.16 | 0.32 | 0.37 |
| | | | |
| D 1 | 0.22 | 0.09 | 0.59 |
| D 2 | 0.34 | 0.39 | 0.39 |
| D 3 | 0.31 | 0.29 | 0.51 |
| D 4 | 0.43 | 0.25 | 0.44 |
| D 5 | 0.38 | 0.27 | 0.52 |
| D 6 | 0.41 | 0.35 | 0.45 |
| D 7 | 0.39 | 0.32 | 0.35 |
| D 8 | 0.39 | 0.31 | 0.41 |
| D 9 | 0.44 | 0.35 | 0.47 |
| D10 | 0.49 | 0.37 | 0.50 |
| D11 | 0.20 | 0.20 | 0.19 |

APPENDIX V-C

*Progressive Matrices*
*Point-Biserial  Correlations*
*-Grades  Seven Eight and Nine-*

| Test Item | Grade Seven | Grade Eight | Grade Nine |
|-----------|-------------|-------------|------------|
| E 1       | 0.42        | 0.29        | 0.46       |
| E 2       | 0.43        | 0.44        | 0.50       |
| E 3       | 0.52        | 0.44        | 0.37       |
| E 4       | 0.58        | 0.54        | 0.50       |
| E 5       | 0.53        | 0.57        | 0.56       |
| E 6       | 0.49        | 0.47        | 0.47       |
| E 7       | 0.42        | 0.40        | 0.40       |
| E 8       | 0.37        | 0.49        | 0.47       |
| E 9       | 0.24        | 0.40        | 0.41       |
| E10       | 0.29        | 0.35        | 0.41       |
| E11       | 0.09        | 0.08        | 0.21       |
| E12       | 0.05        | 0.16        | 0.21       |

# APPENDIX  VI

*Standard Error of Percentiles*

*(Age Norms)*

| Percentile<br>Age | | 25 | 50 | 75 |
|---|---|---|---|---|
| 12-0 | S E | .8 | .73 | .8 |
| 12-5 | Interval | 38.4-41.6 | 42.54-45.46 | 46.4-49.6 |
| 12-6 | SE | .9 | .8 | .9 |
| 12-11 | Interval | 39.2-42.8 | 43.4-46.6 | 47.2-50.8 |
| 13-0 | SE | .77 | .69 | .77 |
| 13-5 | Interval | 39.46-42.54 | 43.62-46.38 | 48.46-51.54 |
| 13-6 | SE | .83 | .75 | .83 |
| 13-11 | Interval | 41.34-44.66 | 45.5-48.5 | 49.34-52.66 |
| 14-0 | SE | .83 | .75 | .83 |
| 14-5 | Interval | 39.34-42.66 | 45.5-48.5 | 49.34-52.66 |
| 14-6 | SE | .9 | .8 | .9 |
| 14-11 | Interval | 42.2-45.8 | 45.4-48.6 | 49.2-52.8 |

*Note: All intervals are at the 95%*
*level of confidence*

## APPENDIX VII

### *Standard Error of Percentiles*

### *(Grade Norms)*

| Percentile | | 25 | 50 | 75 |
|---|---|---|---|---|
| Grade | | | | |
| 7 | SE | .63 | .56 | .63 |
| | Interval | 37.74-40.26 | 42.88-45.12 | 46.74-49.26 |
| 8 | SE | .53 | .48 | .6 |
| | Interval | 40.94-43.06 | 45.04-46.96 | 49.04-50.96 |
| 9 | SE | .6 | .54 | .6 |
| | Interval | 41.8-44.2 | 46.92-49.08 | 49.8-52.2 |

*Note: All intervals are at the 95%*

*level of confidence*